MILITARY

SIGNALS

LAND ★ SEA ★ AIR

ARMED FORCES COMMUNICATIONS ASSOCIATION

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IN THIS ISSUE

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ERRORS OF THE LENS *f* NUMBER

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AIR FORCE
SIGNAL CORPS
NAVY
PHOTOGRAPHY

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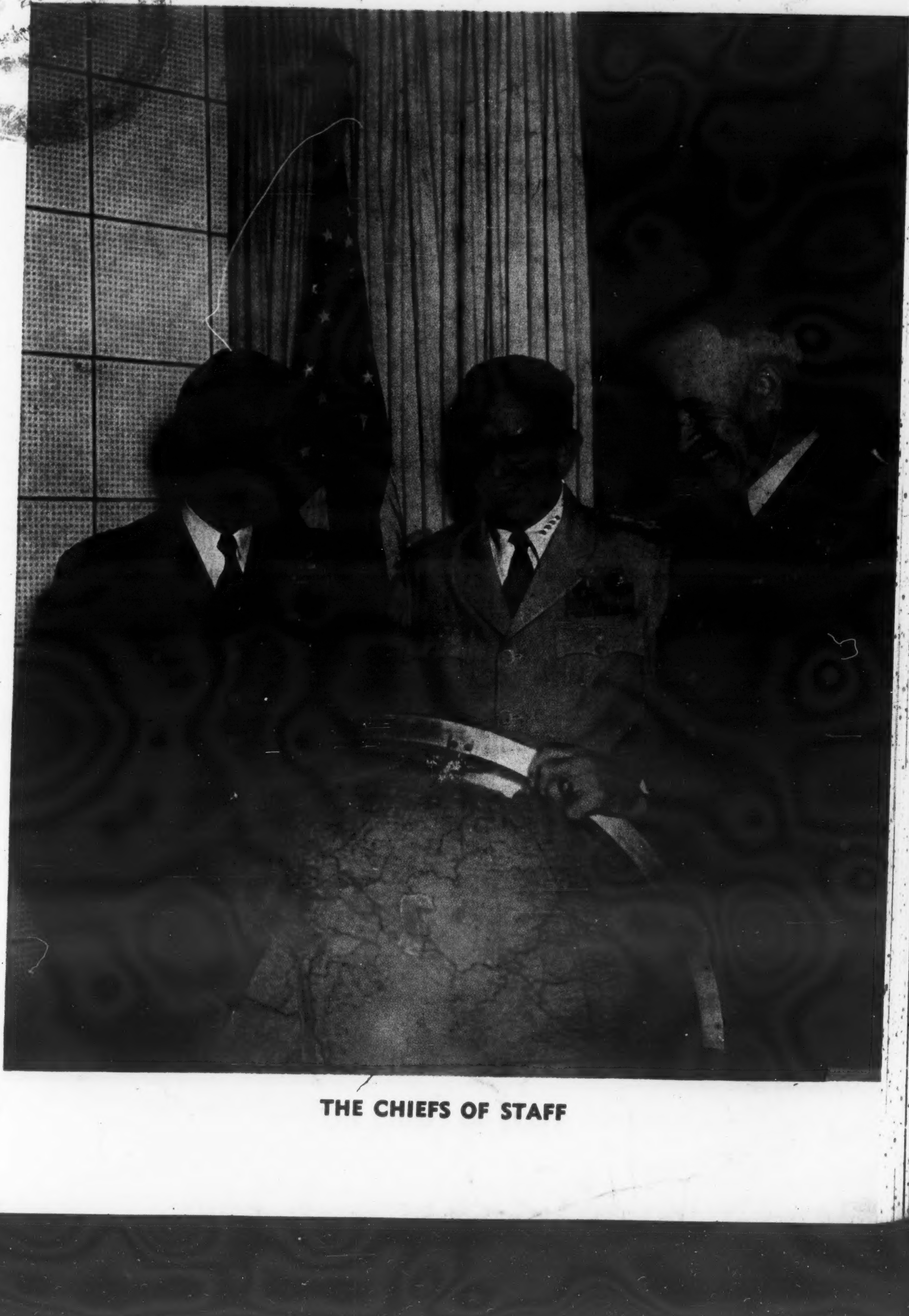
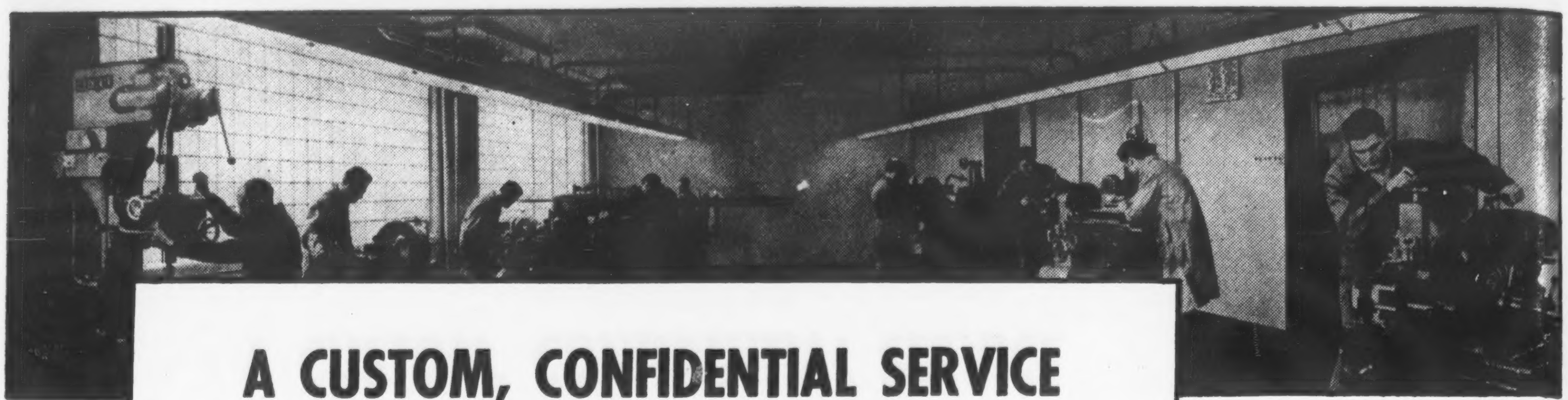
JANUARY
FEBRUARY
1949



THE CHIEFS OF STAFF



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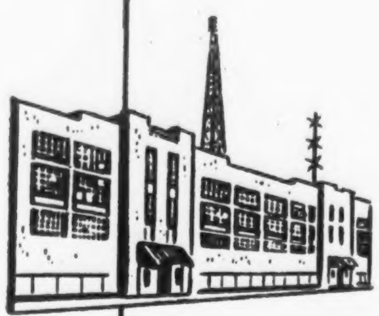

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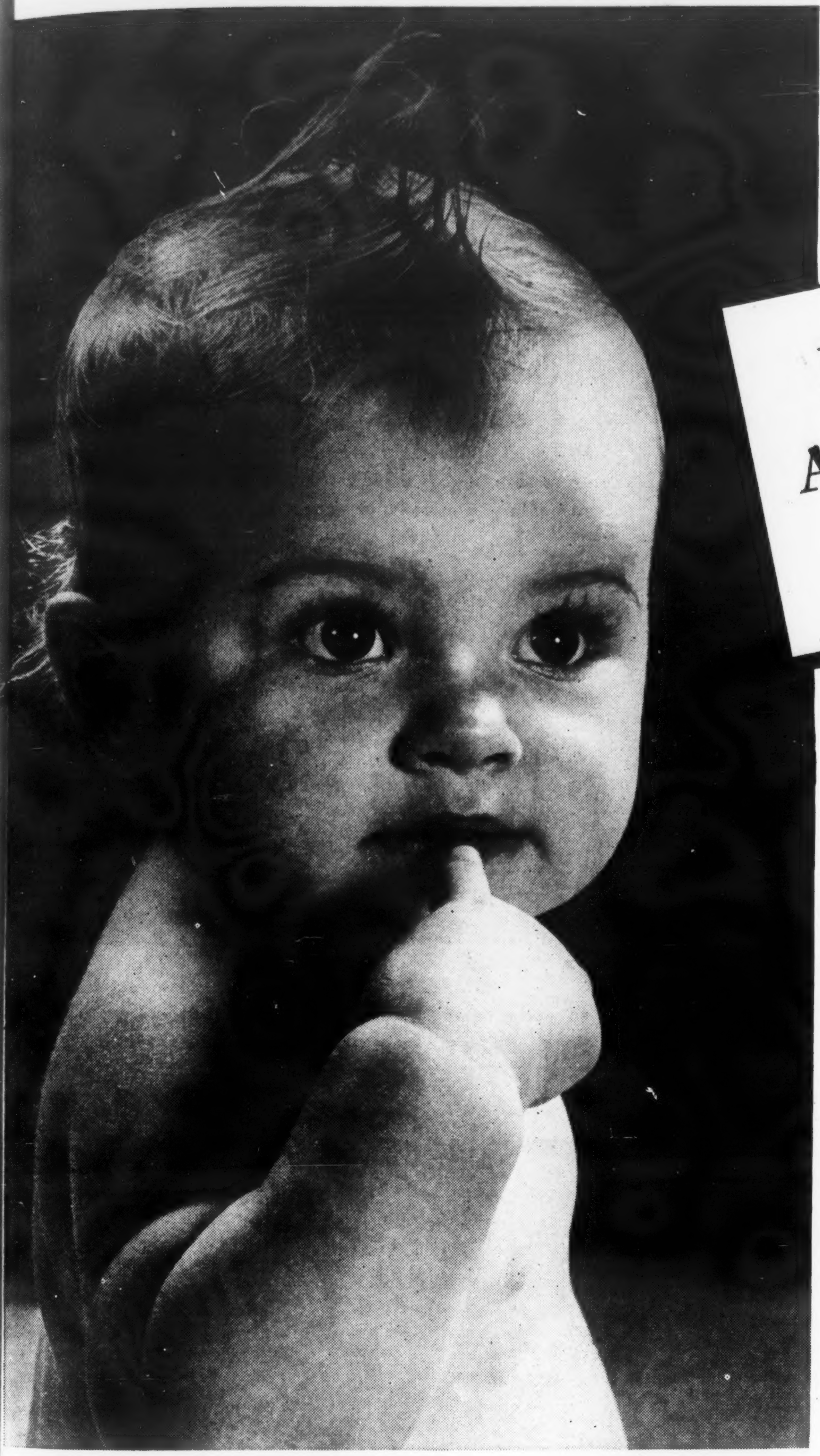
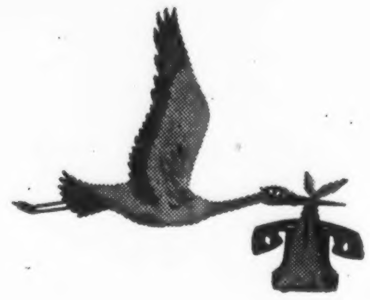
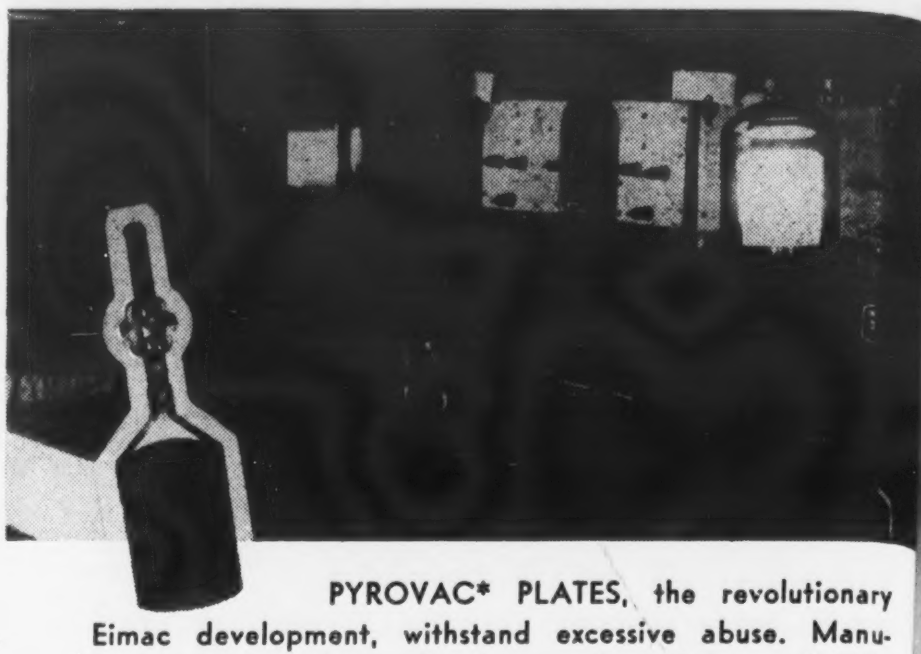




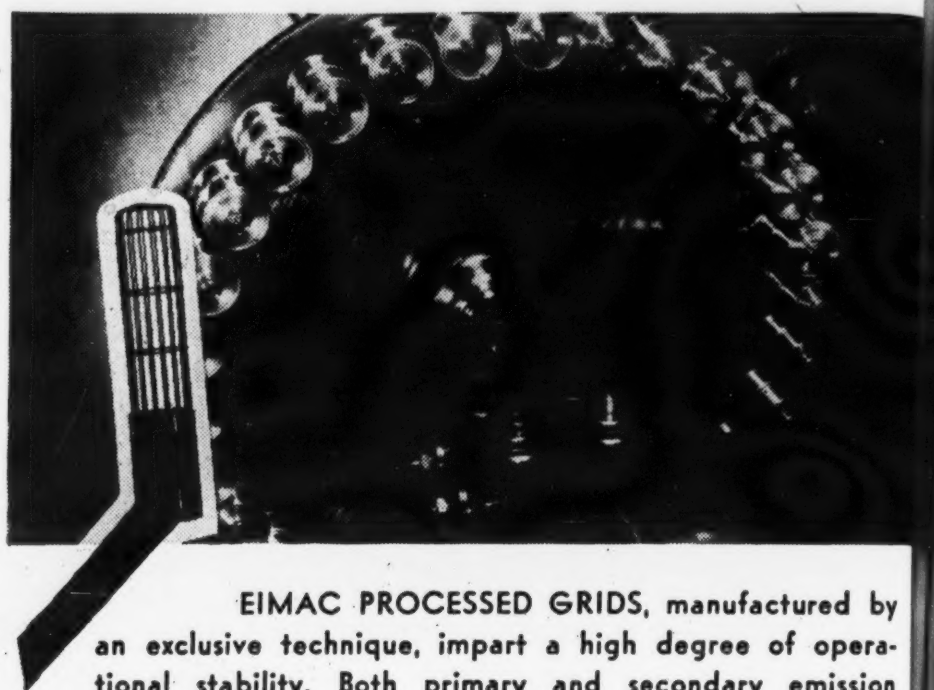
THEY'RE BETTER BECAUSE...

the EIMAC 4-65A

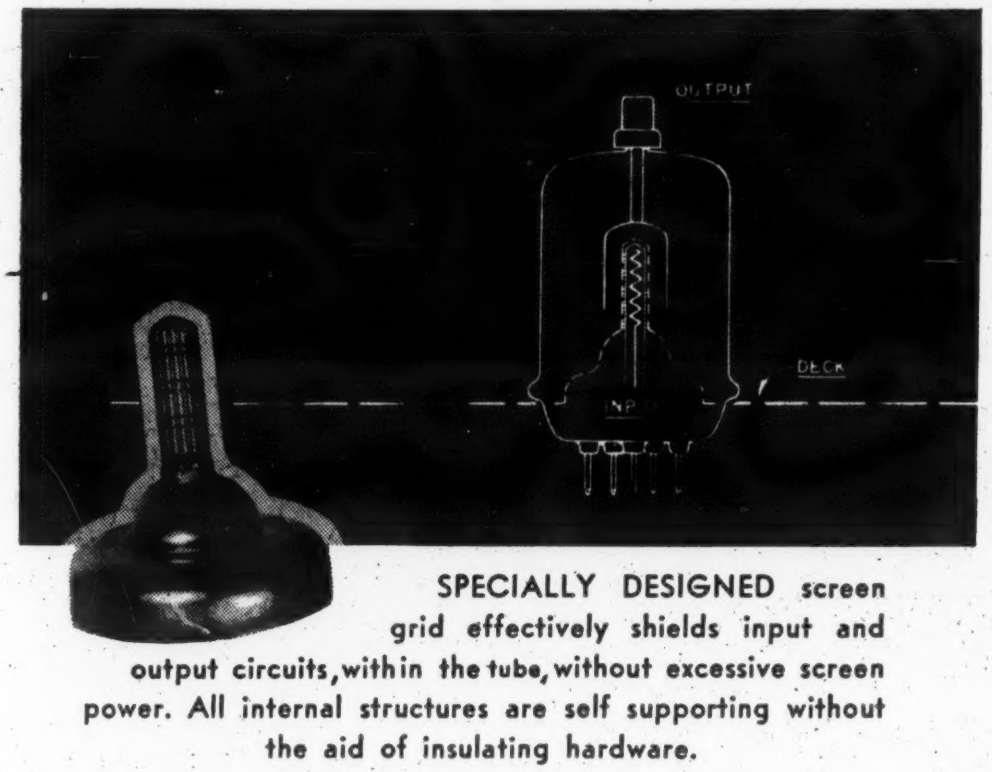
APPLIED RESEARCH by Eimac engineers has produced a thoriated tungsten filament with ample reserve emission. Its instant heating characteristics make the 4-65A well adapted to mobile application.



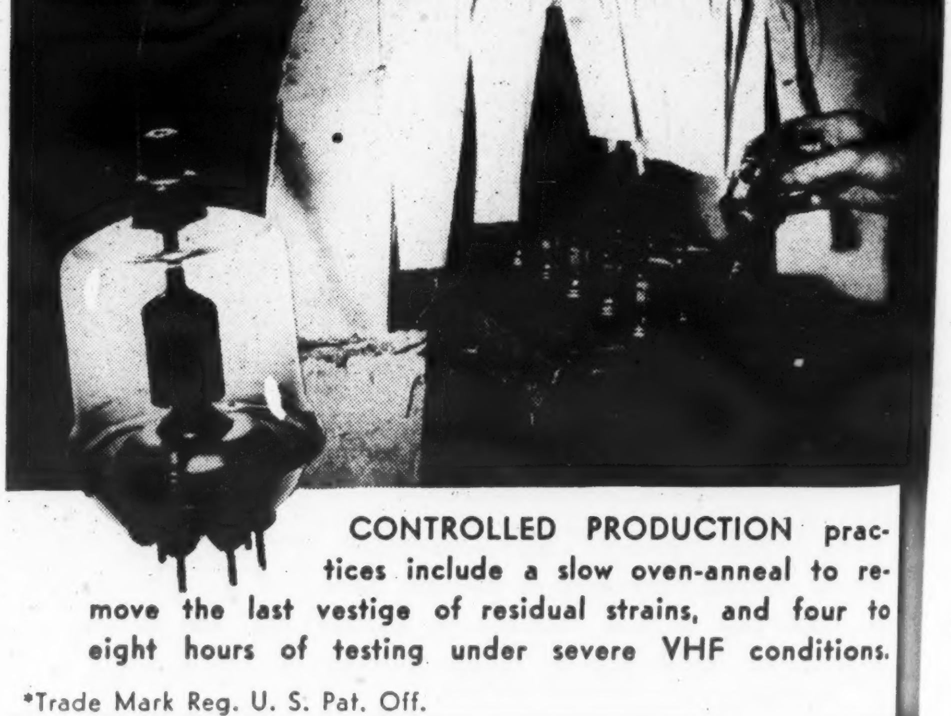
PYROVAC* PLATES, the revolutionary Eimac development, withstand excessive abuse. Manufactured by an advanced technique, these plates can handle momentary overloads in excess of 1000%, consequently they contribute appreciably to the tube's life.



EIMAC PROCESSED GRIDS, manufactured by an exclusive technique, impart a high degree of operational stability. Both primary and secondary emission are controlled.



SPECIALLY DESIGNED screen grid effectively shields input and output circuits, within the tube, without excessive screen power. All internal structures are self supporting without the aid of insulating hardware.



CONTROLLED PRODUCTION practices include a slow oven-anneal to remove the last vestige of residual strains, and four to eight hours of testing under severe VHF conditions.

*Trade Mark Reg. U. S. Pat. Off.

These are but some of the features that combine to make the Eimac 4-65A a better tetrode. It is unexcelled in its category as a power amplifier, oscillator or modulator. For example, in typical operation as a power amplifier or oscillator (class-C telegraphy or FM telephony) one tube with 1500 plate volts will supply 170 watts of output power with less than 3 watts of driving power. A complete comprehensive data sheet on the 4-65A has just been released. Write for your copy today.

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The Power for R-F

MILITARY
SIGNALS
LAND ★ SEA ★ AIR

Journal of the Armed Forces Communications Association — Dedicated to Military Preparedness

VOLUME 3 JANUARY-FEBRUARY, 1949 NUMBER 3

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FEATURES

DEPARTMENTS

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The Cover was posed especially for SIGNALS by the Chiefs of Staff. L to R: Gen. Hoyt S. Vandenburg, C/S, U.S.A.F., WW II commander of the 9th Air Force, ETO; Adm. Louis B. Denfeld, CNO, wartime commander of Battleship Division 9 at Okinawa; Gen. Omar N. Bradley, C/S, U.S.A., WW II commander of the 12th Army Group, ETO.

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THE COVER

New Department

This page begins a new department in SIGNALS. Nameless, so far, it will be a sort of let's-talk-things-over section. It's something we've felt has been needed right along — a place where we can tell you informally something of what's going on around here, and where we can air your ideas about the association and the magazine.

You'll probably find the new section over on the opposite page when it gets rolling. This time that page has been used to tell you about the set-up of the coming convention, and to give those of you who can come a handy form for making your reservation.

Why This Issue

This new department actually thrust itself in out of the necessity for explaining the special issues of the magazine being done. Brief explanations were managed on the contents page for the all-Navy issue and for the extra pages issue with the Hopley report. But this present issue requires a little more than a brief mention. It requires a little more because there is more than this issue involved. All future issues are being affected.

For those who were not in on the beginning of the AFCA and of SIGNALS it will be necessary to start from that period to get at an understanding of the reason for this issue.

The association and SIGNALS had their start with mainly Signal Corps supporters. Since the Signal Corps was equally a communications and photographic service both of its functions became the interests of the AFCA.

But then when the Air Force and the Navy came into the association photography began to fade out of the picture because it was not part of the communications services of the new members.

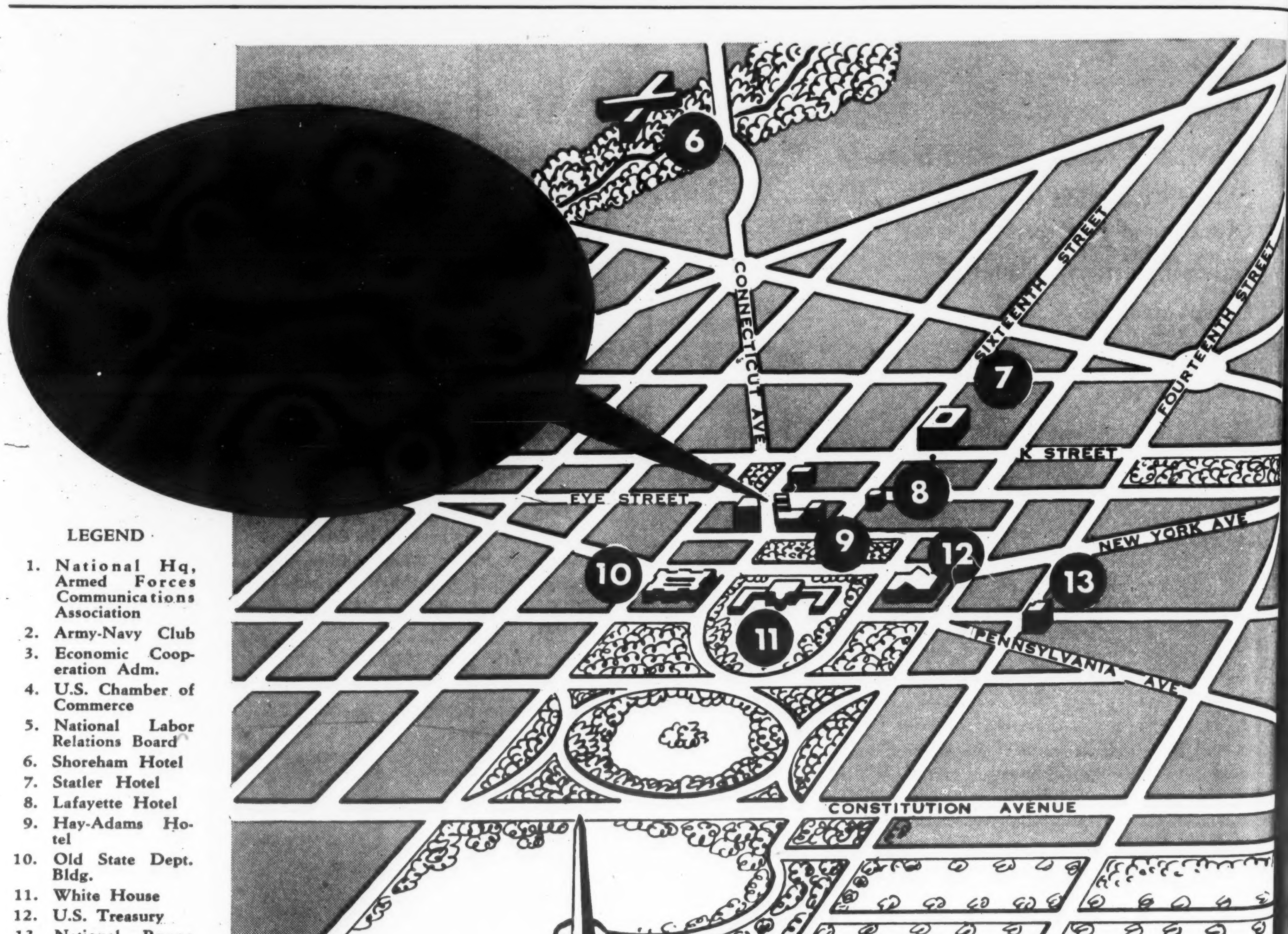
In the meantime, during 1948, the advancement of pictorial electronic communications brought the realization that inevitably photography was going to be a part of all electronic communications. Television was more and more bringing problems of photography to the communicator.[1] And many photographic engineers were required to learn the principles of electronic communications.[2]

Nothing more than television would have been needed to prove the union of photography and electronic communications. But then came Ultrafax to stress the alliance. Publicly demonstrated at the Library of Congress last October, this million-word-a-minute communications system was a joint development of the Radio Corporation of America and the Eastman-Kodak Company, for both the science of electronic communication and of photography are necessary to

(*Continued on page* 60)

[1] "Method of Calibrating Lenses, L. T. Sachtleben, patent assigned to Radio Corporation of America.

[2] Wartime Naval Photography of the Electronic Image by Francis X. Clasby and Robert A. Koch ... "success is dependent upon the exacting application of the best photographic principles, *plus some knowledge of the electronics involved.* The postwar fields of cathode-ray photography are unlimited, and the basic principles as described herein doubtless will be used in the *ever increasing use of photography in the fields of radar, loran, and television.*"



LEGEND

1. National Hq, Armed Forces Communications Association
2. Army-Navy Club
3. Economic Cooperation Adm.
4. U.S. Chamber of Commerce
5. National Labor Relations Board
6. Shoreham Hotel
7. Statler Hotel
8. Lafayette Hotel
9. Hay-Adams Hotel
10. Old State Dept. Bldg.
11. White House
12. U.S. Treasury
13. National Press Bldg.

WASHINGTON GUIDE FOR AFCA CONVENTION VISITORS

THIRD ANNUAL MEETING
ARMED FORCES COMMUNICATIONS ASSOCIATION

at WASHINGTON, D. C.
MARCH 28-29

Monday, March 28

9:00 A.M.	Register at the Shoreham Hotel, Rock Creek Parkway and Connecticut Avenue.
10:00 A.M.	Annual business meeting, national officers and directors, including chapter representatives, at Shoreham Hotel.
12:00-1:30 P.M.	Luncheon at Shoreham Hotel.
1:30-4:00 P.M.	General business meeting, all members. Addresses by the Chief of Naval Communications, the Chief Signal Officer, the Director of Air Communications, the President of AFCA, and his successor. Presentation of AFCA certificates of merit. Orientation by Navy of exhibit and demonstrations.
6:00 P.M.	Cocktails. Shoreham Hotel.
7:30 P.M.	Banquet at Shoreham Hotel. Principal address by Admiral Louis E. Denfeld, Chief of Naval Operations. AFCA's president, David Sarnoff, will introduce the speakers.

Tuesday March 29 (Arrangements for the second day's meeting will all be made by the Navy Department, Captain Robert J. Foley, U.S.N., in charge.)

9:30 A.M.	Transportation from Shoreham Hotel to Navy Exhibits.
10:00 A.M.	Exhibits of Naval communications equipment.
1:00 P.M.	Luncheon at Navy Station.
2:30-5:00 P.M.	Demonstration of Navy communication, photographic and combat equipment.

The meeting this year, sponsored jointly by the Navy Department and our Washington chapter, will be held March 28 and 29, instead of April 4 and 5 as previously announced.

Our directors could not have chosen a location which would have been more attractive to our members. Washington in the early Spring is without question the most beautiful city in the world. We have selected Washington scenes for this issue's photographic section of SIGNALS so that you may be reminded of the capital city's attractions in order that you may arrange a trip here for business or pleasure to coincide with our meeting. The Shoreham Hotel, at which our first day's activities will be held, is looked upon as one of the loveliest in America and the surrounding gardens in the Spring of the year create a veritable fairyland that will make a perfect setting.

We anticipate the largest attendance we have ever had and the finest meeting. Details of course have not been completed. They will be set forth in a special news letter which will go to all members soon. In the column at the left are the general plans. There is an application blank at the bottom of this page which you should fill in and return with your remittance, to ensure your reservation. Arrangements for the first day's meeting will all be made by the Washington Chapter, of which Mr. F. G. Macarow is president.

TO BE ASSURED OF YOUR RESERVATION CLIP FORM NOW!

Executive Secretary
National Headquarters
Armed Forces Communications Assn.
1624 Eye Street, N. W., Washington 6, D. C.

.... (Date)

Please make the following reservations at $14.00 per ticket which is all-inclusive for the sessions of the Third Annual Meeting:

(Please check)

Will Attend	Time	Functions	Number
	March 28		
☐	12:00 M.	Luncheon. Shoreham Hotel	☐
☐	1:30 P.M.	Business Meeting. Shoreham Hotel	☐
☐	6:00 P.M.	Cocktails. Shoreham Hotel	☐
☐	7:30 P.M.	Banquet. Shoreham Hotel If non-member guests are accompanying you please indicate number ( )	☐

Will Attend	Time	Functions	Number
	March 29		
☐	9:30 A.M.	Transportation to Navy Center from Shoreham Hotel	☐
☐	1:00 P.M.	Lunch. Navy Mess.	☐
☐	2:30-5 P.M.	Demonstration at Navy Center (No charge. Membership card or other AFCA identification must be presented.)	☐

I will arrive by ☐ **train** ☐ **bus** ☐ **plane** ☐ **private auto** ☐ **private plane**

My check for $.................... for the above, made payable to the addressee, is enclosed. I understand that I am to make my own train and hotel reservations, unless otherwise indicated below. Send tickets to:

A.F.C.A. Member ....
(Please print)

Street Address..

City, Zone and State..

Please make hotel reservations for .... double room(s) @ $10 daily or .... single room(s) @ $8 daily from .... to ...., and confirm. Reservations to be at Shoreham unless otherwise indicated.

AERIAL RECONNAISSANCE

UNDERGOING BASIC CHANGES

By Colonel George W. Goddard

Chief, Photographic Laboratory
Engineering Division
Air Materiel Command
Wright-Patterson Air Force Base

Colonel George W. Goddard

Col. Goddard has long experience in Air Force photography, as witness the photo on page 11 with the then Lt. Goddard at the controls of a WW I period airplane.

Visitors to the AFCA convention at Dayton last May will remember Col. Goddard's display of three-dimensional color strip film in the photography laboratory theater.

When World War II broke out it as still conceivably possible to use meras and procedures which had en used in 1918, twenty years be-re. But now, in 1948, military sci-ce and its engineering are altering t only the techniques of securing litary information from the air th cameras but the instruments for ch work, the materials used and the ndling of recorded information er it has reached the ground. The gree of flexibility of thought re-ired of our agencies of defense in s uneasy year of 1948 is only dim-realized by the civilian population a whole.

Fundamental changes have been ing place in conditions governing procurement of military informa-n from the air by means of pho-raphy. These changes became ap-ent with the increased deadliness radar-trained anti-aircraft fire and ximity-fused projectiles and have elerated in tempo with the tre-ndous increase in speed and range l altitude of military aircraft.

During these days of semi-peace rules of the game are being radi-ly re-written. We are forced always to be alert to change — in aircraft design and performance, in engineering, in ordnance, in electronics, in photographic components — even changes in the possible locale of theatres of combat presenting differing conditions of topography and illumination.

It goes without saying that we try always to anticipate. Anticipation is an intrinsic, bred-in-the-bone function of the engineering division, Wright-Patterson Air Force Base. Here, a first-class anticipator has always had a high value. Even a reliable Biblical prophet would receive a fond welcome, particularly at the photographic laboratory. He would immediately be given a "P-10" rating and told to keep a sharp eye on those restless aircraft designers, those eager ordnance experts, those imaginative guided missiles people. If such a prophet had been on the payroll at Wright Field, in 1940, he might have told us that a general named Patton would base an incredibly successful military campaign on aerial photographs — photographs not by the dozen but by the hundred thousand. (Fortunately, we guessed right on that one, and had quantity production processing equipment ready in time.)

Examine, as an instance, changes in flying altitudes which may be brought about by the increased efficiency of anti-aircraft fire. We have officers in the laboratory — men who "went through the mill" during the war — who will assure you that what they call the "middle zone in altitude" will be sheer suicide to a photographing airplane flying over modern anti-aircraft fire. They agree that this "middle zone" extends approximately from 500 feet to 40,000 feet altitude, and they maintain that military aerial photography under combat conditions must be handled below or above the two altitudes if at all possible.

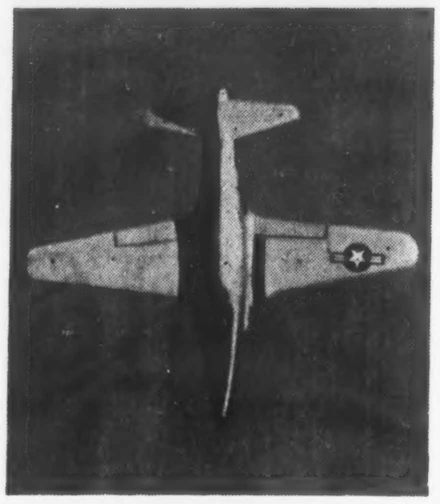
It is apparent that a theory as arbitrary as this might alter basic techniques of photographic reconnaissance to such an extent that instruments, personnel training and the type of information secured from aerial photography would be affected.

The theory, we have found, has attracted not only enthusiastic adherents but violent disagreement. Therefore, while developing instruments for use in low and extremely high altitudes we are not neglecting the well-traveled medium zone. A definite answer to the question will undoubtedly be given us during the first few weeks of any future conflict.

Photographic airplanes coming in "on the deck" must be extremely fast and must carry cameras of a type changed in design from those which have been considered as standard in the past. If we persist in using conventional shutters on our cameras, we must begin to think in terms of thousandths of a second. During a shutter click as brief as 1/500th of a second in a camera in a jet airplane racing over the tree tops at 500 miles per hour the camera in the airplane would move more than 1½ feet, blurring the picture. Two other new factors enter the picture — one the problem of uncovering and covering a large lens at high speed, and the other the quantity of light necessary to register on a negative in an extremely short interval of time.

The Strip Camera

To a great extent, we are glad to say, this low-level high-speed situation has been foreseen by our "anticipators." To meet it we have already perfected film magazines with image motion compensation; accurately calibrated mechanisms which move the negative and the image it is receiving in exact synchronism with the motion of the image as it comes through the lens. For even faster speeds we are perfecting and using with considerable success the strip



1000 mile per hour photograph of P-80 made with strip film camera. This was the cover photo of the May-June, 1948 issue of SIGNALS.

camera which uses no shutter of any sort whatsoever, receiving the image through a slit which "wipes" a picture on a long strip of film which moves in synchronism with the ground speed of the airplane. Robot-like, automatic scanners, capable of analyzing aircraft speed by an optical pick-up directly from the ground below the airplane are incorporated into the camera, exactly controlling the speed of the film. Theoretically, the only limit on the speed from which such a picture can be taken is the mechanical strength of the film and the speed of the photographic emulsion.

In an interesting test, which was nationally publicized, Wright Field engineers and two P-80 pilots cooperated in producing aerial photographs with the strip camera at a simulated speed of one thousand miles per hour, a figure somewhat above the present top speed of reconnaissance aircraft. Two P-80 airplanes were flown in opposite directions in the same flight path, one passing 500 feet directly over the other, the top airplane carrying strip cameras. Although the ground speed of the two aircraft was five hundred miles per hour, their relative speed as they passed was, of course, one thousand miles per hour.

Film was passed through the strip camera at a speed of 70.56 inches per-second. Almost perfect pictures were secured, with distortion less than 2% and absolutely no trace of blur. Definition was as perfect as if the lower airplane had been resting on the ground. Decidedly, this type of camera is the answer to the requirement for reconnaissance photography at low altitudes and extremely high speeds.

New Giant Cameras

Considerable work has been done to provide satisfactory photographs from the upper side of the "middle zone in altitude." Conditions change radically with high altitude. Fast airplanes, capable of evasive tactics are an advantage in this region, of course. But the type of camera used must change, requiring often a change in the carrying airplane. To secure detailed delineation of ground objects focal lengths of lenses must be lengthened considerably, narrowing the field of view of the camera and automatically establishing a requirement for more cameras to give more complete coverage. The weight and bulk of such photographic equipment results in a tendency toward the use of multi-engined airplanes, such as the B-29, the B-50 or the XR-12 (Republic Rainbow). The almost unbelievable photographic coverage achieved by the XR-12 in less than seven hours during its non-stop flight from the Pacific Coast to the Atlantic is a sample of results to be expected from high-altitude photography. The three K-17 Cameras covered a strip from horizon-to-horizon, 490 miles in width, from coast to coast, a total coverage of 1,500,000 square miles. This photographic performance was achieved with standard USAF equipment.

Tests are now being run on long focal length aerial cameras which will make present standard aerial cameras look like playthings. Consider the 100-inch, K-30, which only faintly resembles an aerial camera as it is visualized by the layman. Because of the long focal length of this camera it was necessary to "fold" the light path within the camera into the form of a figure "4." Otherwise, the camera and its magazine would have protruded above the top of the airplane that carried it. The "folding

490-mile-wide strip photographed in less than 7 hours.

Modern camera installation in jet airplane . . .

as done by the use of heavy plate lass mirrors, reflecting the light rays ack and forth and directing them to 9-inch x 18-inch negative. Many xcellent pictures have been taken by e K-30 from the forty-thousand-foot one, one of which clearly depicts a ow of fence posts each less than six nches in width.

The spade work in the high-alti-ude region has largely been accom-lished. If time and money do not un out, photography in the thin alti-udes will be more than equal to re-uirements in any future conflict.

Aerial Stereoscopy

The strip camera lends itself ad-irably to stereoscopic aerial pho-ography in black and white or color. onths ago we began adapting it to blique aerial photography and re-lts have been very satisfying, al-ough a number of odd optical prob-ms have been encountered. The ost peculiar of these has been the imination of the "bulge." For onths the "battle of the bulge" ithin the Photographic Laboratory eemed to rival in intensity the mous battle in Europe during the st year of the war.

Although perfect in detail and in olor all stereo oblique photography resented the viewer with an objec-onable characteristic in that the iddle foreground assumed a false nvexity, bulging to such an extent at it seemed that the airplane which ok the picture must have been fly-g parallel to a high ridge in the ter-in. Considerable study to determine e exact optical laws underlying the enomena was necessary before the oblem could be attacked. From a echanical standpoint, however, the lution was comparatively simple, volving simple changes in the slits which wiped the picture onto the moving film. Corrected cameras have been used to photograph in stereo and in color bomb-damaged industrial areas in Germany and the result forms a record and a historical document of great interest. These pictures simulate reality to such an extent that many times we have been accused of photographing beautifully constructed miniatures.

Faster Color Processing

This type of photography represents the ultimate today in reconnaissance value. It may be secured from low-flying aircraft and high speed has no effect on its quality. When color film is used in combination with stereo the photography is almost sure to penetrate just what an enemy force is doing or trying to do.

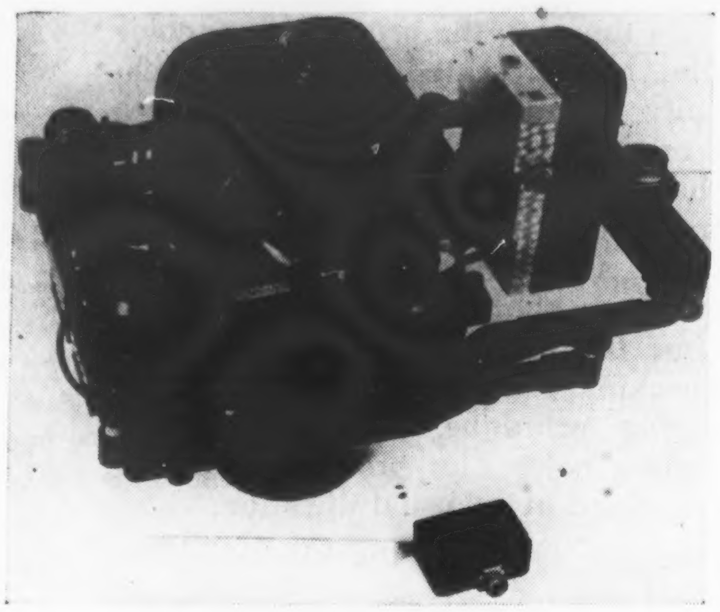
In the past, the processing of color film has presented some little difficulty to advanced field units, both from a technical standpoint and from that of time required for development. We hope, however, that technical problems will be overcome within a short time. At the present time the photographic laboratory is checking experimentally a fast processing technique, which promises to reduce color film processing time to one-third of its usual duration.

Accuracy Need in Mapping

Few of the uninitiated realize that stereoscopic photography from the air has a secondary attribute distinct from its pictorial value. All of the services, not only of our country but those of foreign powers, possess instruments capable of measuring objects pictured in aerial photographs taken in stereo. In our services such instruments were considered to be accurate within one foot when used in an analysis of aerial photographs taken from 500 feet or under. Improvements in the direction of still greater accuracy are now well advanced.

There are two general classifications of military aerial photography, reconnaissance and mapping. Reconnaissance photography places emphasis on clarity of detail and rapidity in the handling of the pictures through processing. It does not insist on mathematical accuracy in the pictorial placing of objectives nor does it seek to maintain technical perfection in processing. Material

. . . for reconnaissance photography at low altitude and high speeds.



First successful automatically stabilized camera mount.

derived from it is often used in the preparation of charts, mostly for aerial navigation use. Somewhat different conditions are imposed on photography secured for mapping purposes. Speed is required in production of the finished article, the picture is slower in tempo, but requirements for accuracy are almost incredibly severe. It should be borne in mind that such material forms not only fundamental data for strategic planning and actual military operations, but in days to come may be the basis for electronically controlled bombing through overcast or during the night hours by such means as radar or shoran, or for the accurate placing of robot or guided missiles, where a variation of only a few degrees in trajectory of perhaps a thousand miles might place a very successful explosion a hundred miles from a target.

Stabilized Mount

The accuracy desired by mapping authorities who use material secured from aerial photography might at first glance seem to be impossible of attainment. From their standpoint, however, requirements are not unreasonable when it is considered that a deviation from perpendicular of only six minutes of arc in a mapping camera taking a picture at a 20,000-foot altitude will cause a horizontal shift of 29.5 feet in the placement of a photograph of a ground area, and give a theoretical lift in elevation to a point in the photo of 21.7 feet; changing altitude calculations of terrain and point locations to a serious degree.

Some type of stabilized camera mount is indicated, of course. This fact was recognized before World War I had come to a close. Since that time, millions of dollars and hundreds of thousands of manhours of time have been expended by domestic and foreign services, both commercial and military, in the search for a solution to the tantalizing problem of camera stabilization. Here was a situation where engineers and scientists openly agreed upon and discussed various aspects of the problem, but no one seemed to be able to do anything about it.

Gyro With Optical Pick-off

Requirements established by our corps of engineers meant that we must devise a mechanism for use in a flying airplane which would hold a camera to a perpendicular position within limits which, from the standpoint of rotation about an axis, may be visualized as the thickness of a lead pencil mark on the edge of a disc four feet in diameter. Stabilization has been applied to bombsights and to navigation instruments for years with some success, and at first glance it might seem that camera stabilization required only a process of adaption. Such is not the case, however, as camera stabilization has problems peculiar only to itself.

Photographic Laboratory, Engineering Division, at Wright Field, was able to announce this year that it had designed, constructed and was flight testing an automatically stabilized camera mount which was performing within the stringent requirements. The announcement marked the climax of over two years of intensive effort on the part of four very capable USAF engineers each a specialist in his own line, spurred on by pressure which has become more and more insistent.

The nucleus of their mechanism is a powerful gyro, with a novel optical pick-off and a control over the gyro which not only erects it into operating position but forces it to maintain a perpendicular position regardless of airplane travel in a geographic sense, automatically compensating for changes in latitude during the flight of the airplane, for changes in relative angle between the gyro and the surface of the earth due to the earth's rotation, and for centrifugal and acceleration forces which filter through the suspension to the gyro rotor.

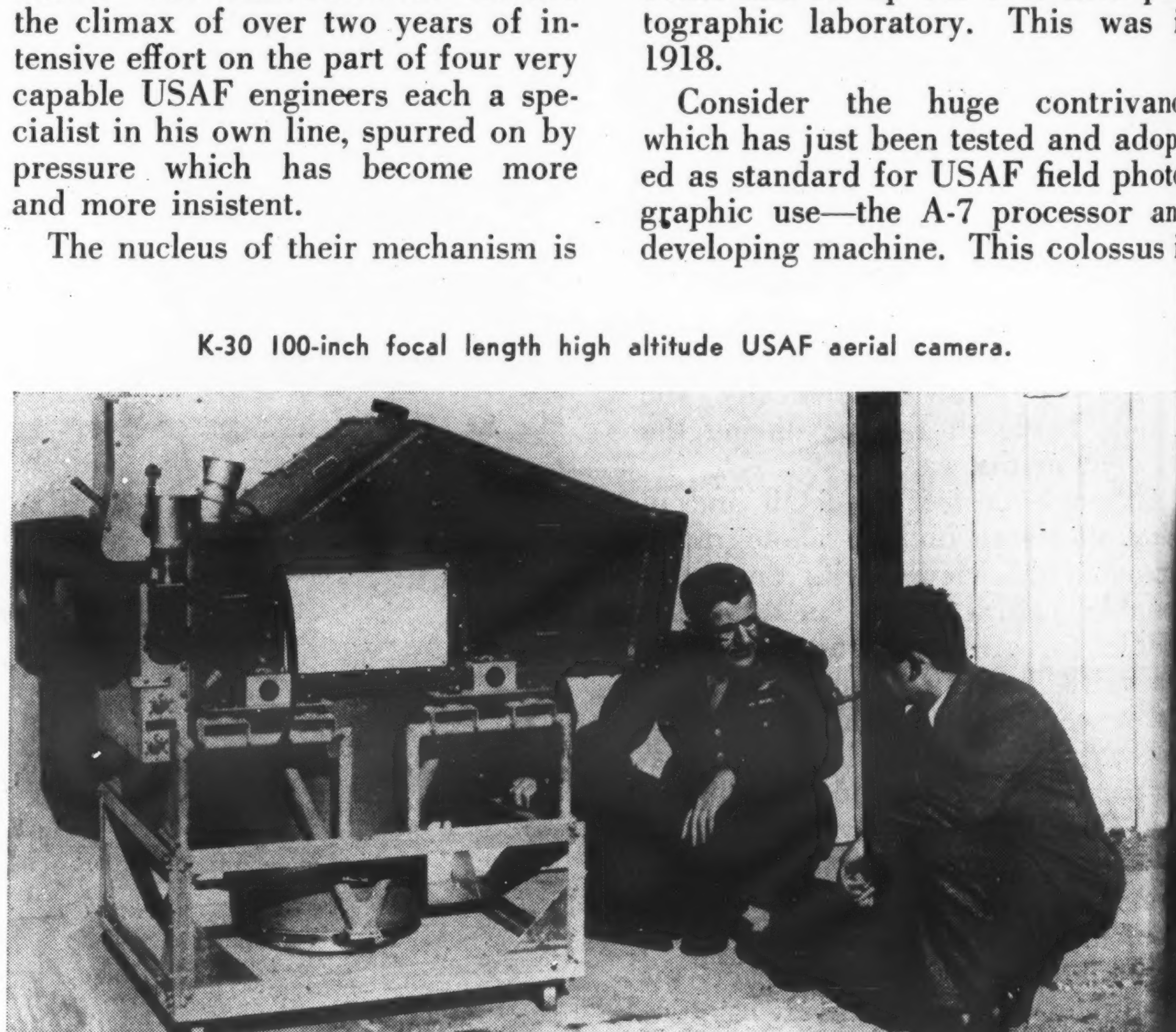
Cameras in this mount, operating far from home base, will provide excellent photographic material for maps of enemy objectives without the usual ground control. Tilt and distortion will be at a minimum and the photography will have increased sharpness as well as accuracy, facilitating the work of photo interpreters.

New Field and Flying Labs

Our laboratory anticipators have been preparing to meet the requirements of future General Pattons who may believe even more fervently in an adequate supply of photographic prints. At this point it becomes obvious to some of us that a great deal of time has elapsed since the days when we, in our Kelly motor truck, steamed up to a clearing in the woods, unpinned several tent flaps, dragged out bottles and bags and boxes and set up our first field photographic laboratory. This was in 1918.

Consider the huge contrivance which has just been tested and adopted as standard for USAF field photographic use—the A-7 processor and developing machine. This colossus is

K-30 100-inch focal length high altitude USAF aerial camera.



capable of producing 12,000 finished 9-inch x 9-inch photographic prints in eight hours, requiring the attention of only two men. In the last war a production of 3500 prints by twenty men in 8 hours was considered reasonable. When your imagination has assimilated this modern application of production-line techniques to intelligence material, let it go a step farther and consider the flying field photographic laboratory, complete in every detail, with machinery, crew and supplies, traveling in the air at three hundred miles per hour to its point of use. It is based on the detachable hull concept originated by the aircraft laboratory, at Wright Field, and it has the unqualified approval of the photographic laboratory. Briefly, it consists of a large hull, similar to that of the C-82 cargo carrier, with a detachable wing and tail structure containing a two-motored power plant. The powered section releases the hull section at a desired location, and flies back to its base for an electronics lab, a machine shop, a hospital, or any one of a dozen possible types of unit. One powered unit and its crew can handle the air transport of many hulls without the immobilizing of a number of crews and power plants as would be the case at the present time.

You might assume that our anticipators, working without pause along lines of endeavor suggested by a war which is supposed to have finished three years ago, would by now have things well in hand. That they should be confident that their machinery and instruments and techniques are ready and waiting, with the originators satisfied that now we can take care of any reasonable situation. Believe me, such is not the case.

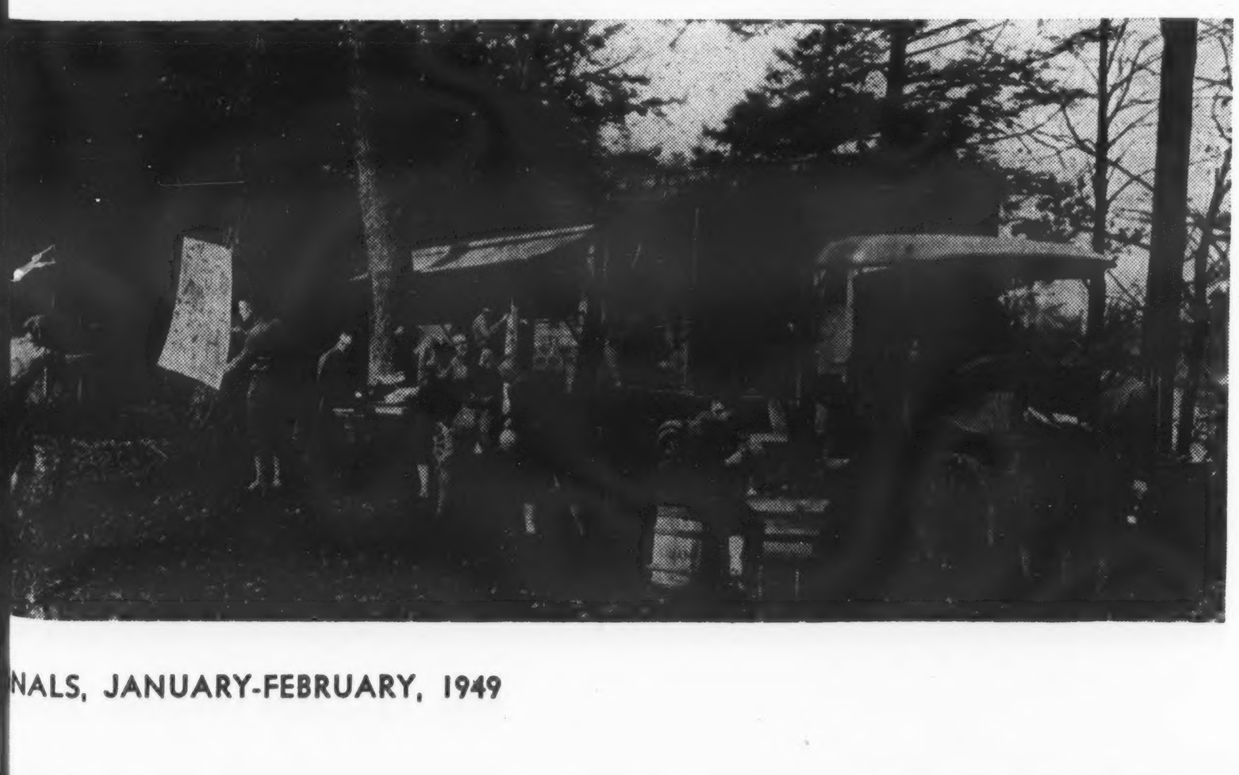
The anticipators are worried, and with good reason. The underlying cause of their worry may be found as far back in military history as the famous Maginot Line. They say that it represented the end of a cycle, a point in the turn and turn about between military attack and defense which has gone on for three thousand years. The Maginot Line represented the apex of a defense cycle. According to its builders, it represented, with a flourish, the final victory of the defense over the offense. It was the ultimate, the impregnable.

Early camera installation in Army airplane, Lt. George W. Goddard, pilot. Dr. Burka, camera man and physicist.

Cycle of Change Still On

But we all remember that it did not save France. It was by-passed, cut up, taken from the rear, ignored. In twenty years of peace a strange animal called blitz warfare had come to a dreadful maturity. The attack was again very much in the ascendant, striking paralyzing blows at sixty, one hundred, three hundred miles per hour. Concentrated fire power on wheels behind armor, howling Stukas, new conceptions in the organization of striking units, the strategy of mobility and speed, of rapid transport, and of surprise had again re-written the books of military science and the cycle of the attack was on. And, beyond doubt, it is still on.

"We steamed up in our Kelly motor truck, and set up the first field photographic laboratory."



Aerial Photo Survey Vital

We are becoming used to the phrase ". . . there is absolutely no defense." By luck and by ingenuity we have weathered a storm of such devilish contrapions as the V-1 and the V-2 and the kamikaze. Our enemies have been so unfortunate as to have come in contact with gasoline-jel fire bombs, thousand-airplane bombings and the awful destruction of the atom bomb. No one seems to be devising impenetrable armor plate, or disappearing bomb-proof shelters.

Perhaps if the attack continues upward in its cycle, becoming more and more destructive and more and more sure of eliminating its targets, the only factor of uncertainty will be the primary task of accurately locating the target to be destroyed. After it has been pin-pointed on an accurate map, its destruction will be almost automatic.

Our anticipators believe that reconnaissance, particularly by means of aerial photography, will become even more vital in importance. That the paramount issue, perhaps the deciding factor of an entire campaign, may be whether or not a photo airplane gets in, gets a photo, and gets out again. One of our anticipators has expressed it like this, "In the next war, once they take your picture—that's it! Brother, you've had it!"

EDITORIAL

Darryl F. Zanuck was appointed in 1941, in the rank of lieutenant colonel, to head the production of training films for the defense forces of the U. S. Promoted to colonel in 1942, he supervised photography in the African invasion and subsequent action, and for this was awarded the Legion of Merit.

Overseas in the 1st World War, Col. Zanuck was on the staff of Stars and Stripes. After the war he went to work at Warner Brothers Studio as a writer. He became scenario editor, and then chief production editor. In his present position as vice president in charge of production for 20th Century-Fox he has won numerous producing honors, including the academy award twice. Col. Zanuck is vice president of the AFCA.

All of the photographic services of the U. S. armed forces suffered in common from two basic illnesses, to a varying degree, all through the war. These ills were, first, a fairly universal lack of full cooperation, and therefore of full use, from Washington to the fighting fronts. Second, lack of coordinated control at the level of the Joint Chiefs of Staff.

Both ills sprang, in my opinion, from the same germ—general lack of knowledge throughout the military and naval structures of the nature and importance of the overall photographic mission.

Some few individuals saw the entire problem. A larger number recognized part of the problem. But, by and large, too often through all ranks and grades the photographic mission was an irritating gadfly—sometimes to be slapped down, more frequently to be brushed away, and too often merely to be ignored.

Actually, the photographic services were of incalculable value. Their achievements under handicaps was a miracle on a parallel with the similar miracles performed by other relatively new and undeveloped services throughout the armed forces. But the photographic services were never used to full capacity, they never approached peak efficiency, due, I think, to the two fundamental weaknesses emphasized above.

This is where the Armed Forces Communications Association, and its journal SIGNALS, can step in and play a vital role. For the first time all of the photographic services — Army, Navy, Air — have a common meeting ground. And for the first time they have an open forum where they can be heard (and I hope understood) by their brothers-in-arms, whether wearing five stars or a clean sleeve. No finer opportunity could have been afforded the various photographic services to clarify and explain, to give understanding throughout the armed forces. Unless they now use that opportunity they will never be able to operate to their fullest value as an instrument of war.

The photographic function is an enormous one. It has tactical application, strategic application, propaganda application. It is used in research, in medicine, in industrial processes. It touches somewhere, whether in large or small measure, upon nearly every aspect of a nation at war. It is as broadly spread in its use as is any other single instrument used by the armed forces.

Balanced against this sweeping mission are tremendous problems of production, distribution, and manpower. Starting with the basic ingredient or raw film stock, all photographic services use materials critically short in supply, as well as equipment slow and difficult of procurement. Their distribution networks touch every unit of the armed forces—and the civilian, enemy, and allied outlets are identical for some of their completed informational film product. They use manpower in skilled categories of which there is desperately short supply.

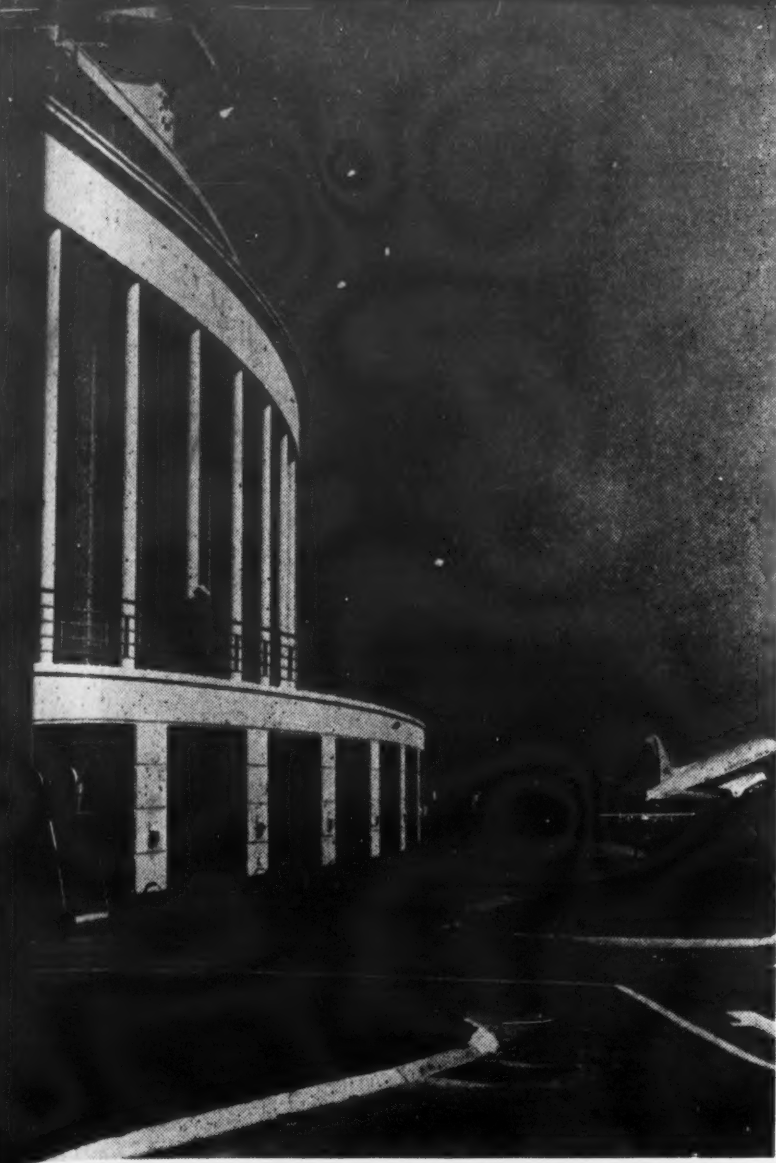
Nowhere does there exist a better illustration of the values which must accrue through unification of the armed forces. Within the three basic teams themselves lies much of the means for curing the first weakness hampering their photographic services—to effect an understanding of the photographic mission through all ranks and grades. But, it seems to me, only through *joint* coordinated action will the larger problems of supply, distribution and manpower be solved effectively.

These are tangible steps which can be taken now, and by existing establishments, to eliminate those handicaps which in World War II kept the photographic services from operating at full efficiency. Every arm, every service, suffered similar handicaps to greater or lesser degree. Only by frank and present stock-taking can future difficulties be eliminated.

There is one more factor equally important, which is, I think, linked inextricably with the two problems I have discussed. That factor is the expediting of building to full strength our alert and interested photographic reserve. There can be no greater stimuli to recruitment than these: recognition, both within and outside of the armed forces, of the mission of the photographic services and a definite and coordinated pattern of operation among the three great services.

SIGNALS and The Armed Forces Communications Association can be the greatest single force in bringing about these measures which will prepare our photographic services to function at the highest peak of efficiency.

Darryl F. Zanuck

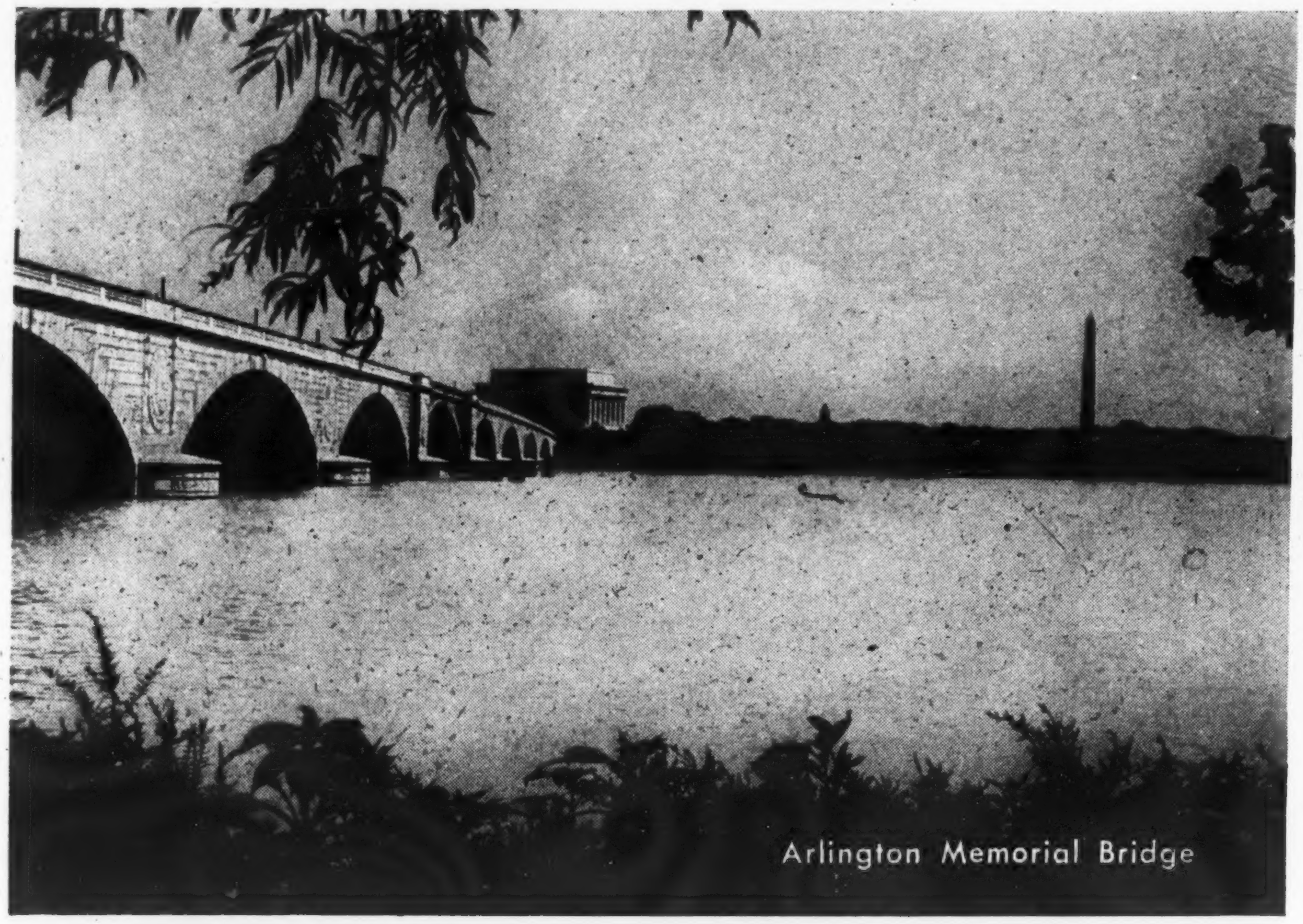


WASHINGTON, D. C.

Convention City This Year for AFCA's Annual Meeting

If you're going to the meeting by air you may get these views as you arrive in the nation's capital. Upper left—the National Airport; Right—the Pentagon, world's largest building in floor area; Below—looking west down the Mall and Pennsylvania Avenue. In the foreground are the Capitol, the Senate and House office buildings, the Supreme Court, and the Library of Congress.

The Supreme Court



If the AFCA convention visitor drives to Washington and approaches from the west he will get the view above crossing the Arlington Memorial Bridge.

Right—the Union Station

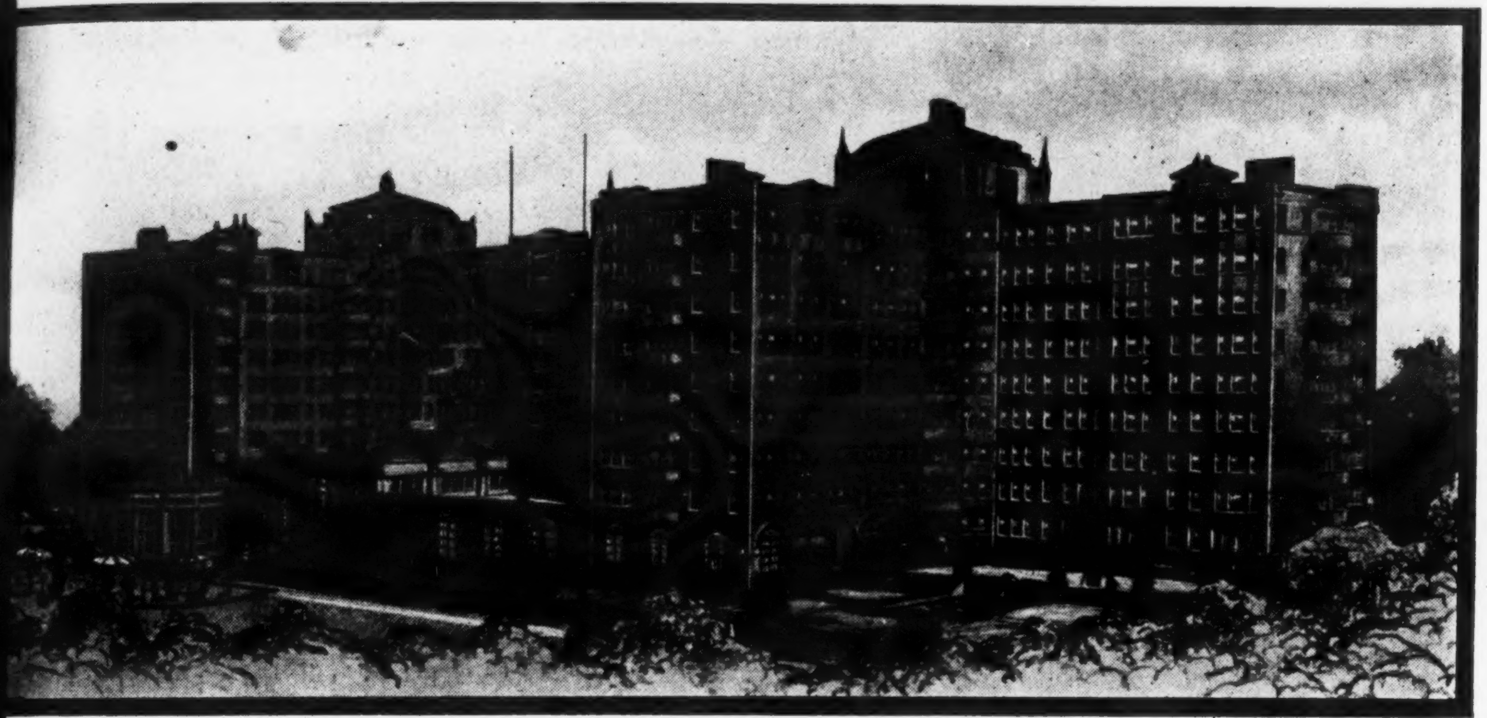
The Lee Mansion and the L'Enfant tomb.

Washington as seen from the Lee Mansion

The Capitol as seen from the Treasury looking down Pennsylvania Avenue.

The Capitol

The White House

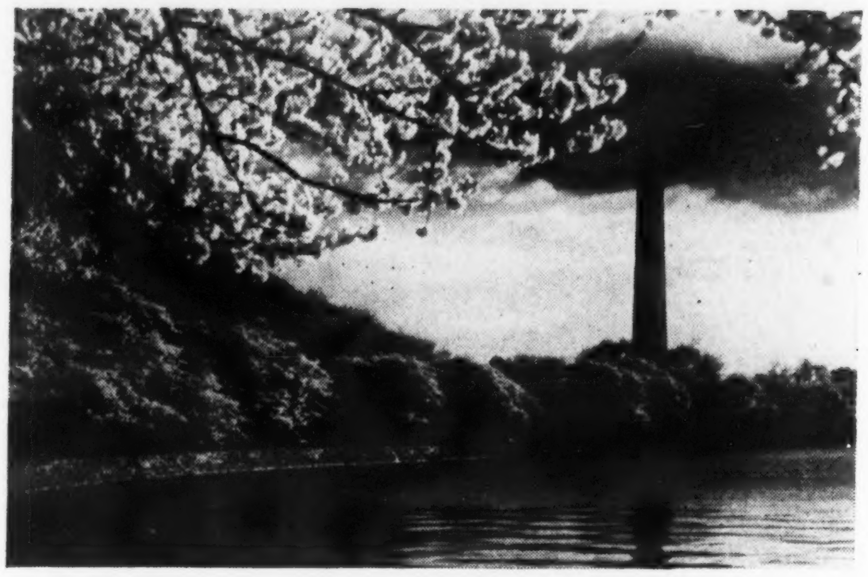


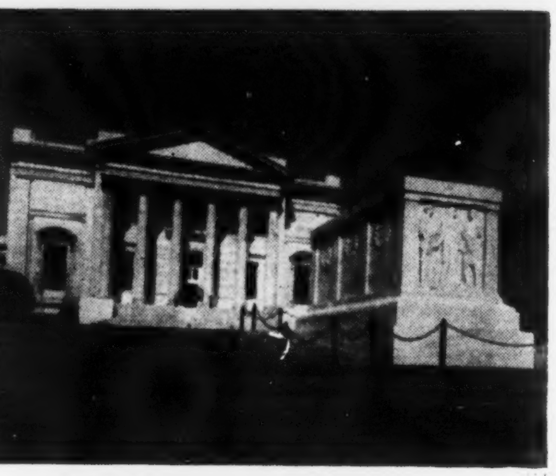
The Shoreham Hotel in Rock Creek Park, site of the business meetings and banquet for the AFCA's third annual meeting.

The National Gallery of Art, sometimes called the Mellon Gallery, in honor of the principal donor, Andrew Mellon.

' The Lincoln Memorial

The Lincoln statue within the Memorial.





Arlington Cemetery. Tomb of the Unknown Soldier, and entrance to the Amphitheater.

The famed cherry blossoms of Washington in springtime draw thousands of visitors to the capital city every year. If Nature will cooperate, and not hold out for a late spring this year, AFCA convention visitors may have the glorious sight of cherry trees in bloom around the Tidal Basin as a sightseeing bonus while in Washington.

The Washington Cathedral.

The Army Pictorial Service has some new photographic gadgets and methods coming up. Here some of them are outlined.

Photography is a weapon, a weapon that is most effective when used with speed before tactical situations change.

NEW EYES for the ARMY

By Donald Becker

Soon, now, the major would have to lead his men across that murky, twisting stream. It would expose them to heavy enemy fire. That meant casualties. The major wanted the crossing to be quick, and he wanted it to be where natural cover was best, the enemy most vulnerable.

But knowledge of that particular pin-point on the battlefield of this future conflict was sparse. The major was operating blindly; he needed eyes.

Eyes the Signal Corps had provided him, eyes in cardboard boxes.

The major sent out a patrol. It happened that none of the division's photographers could go along, so in his pocket each man of that patrol carried a collapsible, expendable camera with a plastic lens. While the patrol scouted the terrain where the stream-crossing would be made its men photographed the area. After each soldier made his picture he pulled out the film and disposed of the camera. When the patrol returned, the major had nearly complete photographic coverage of the area he soon would assault.

But the major wanted a few aerial shots to fill out the picture story. So he called his division commander and asked that a photographer from the division's signal company be flown over the assault area in an artillery liaison plane. This was done. The aerial pictures were quickly processed and rushed to the major.

Now the picture story was complete. Ground detail and air perspective both had been obtained. More to the point, the story was completed before the tactical situation could change.

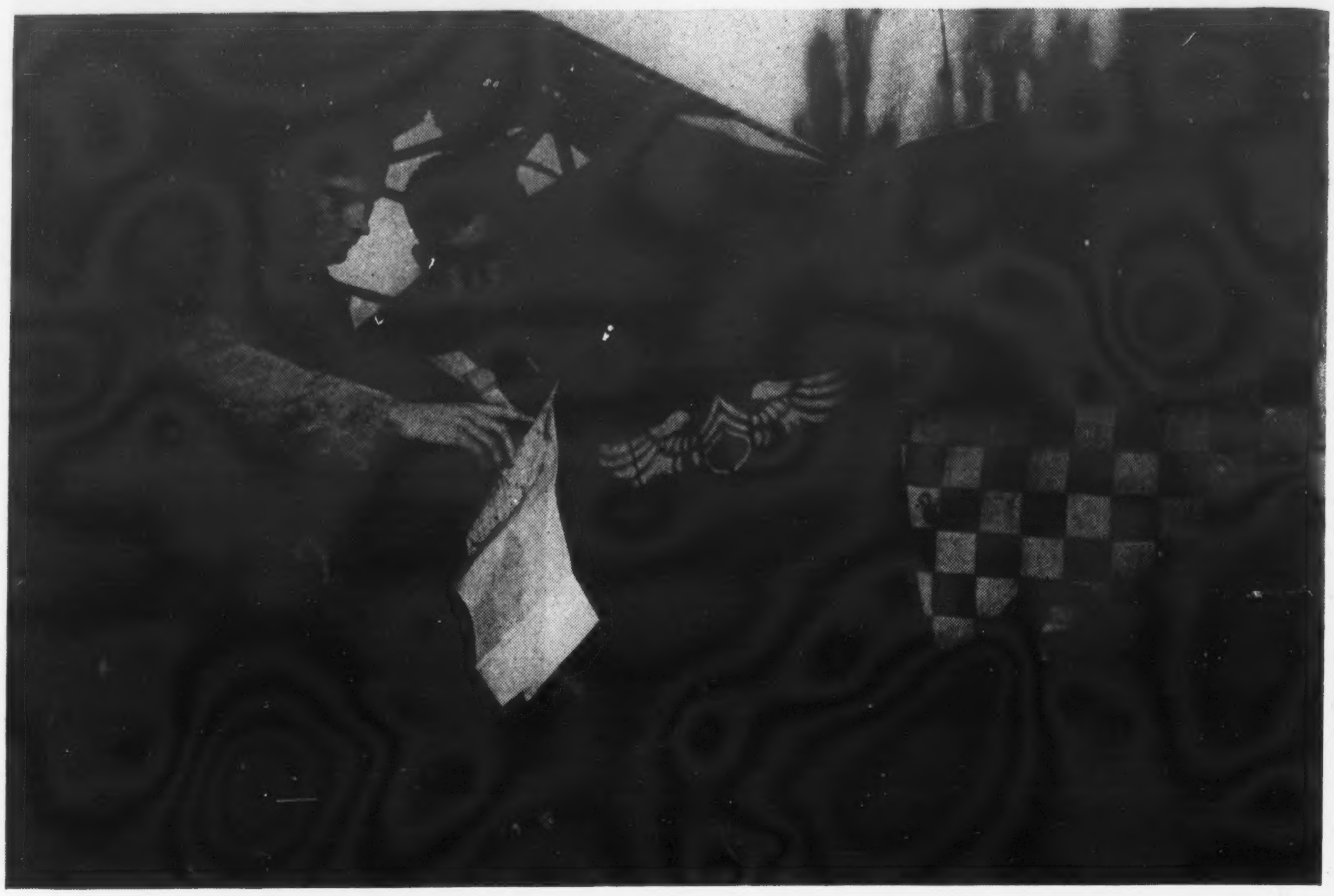
☆

Of the many lessons taught by World War II, one that has guided much post-war Signal Corps thinking is the importance of providing photographs for tactical use quickly. In an age of speed that produced combat marked by mobility, much of the effort of World War II Army photographers was lost so far as some field commanders were concerned. History was recorded fully and the press and news reels were served adequately by Army Pictorial Service's combat photographic teams, but the front-line commander who needed pictures could not always get them in a hurry. Photography yielded a significant indirect contribution to American victory as a training aid and in strategic studies, but nothing approaching its full tactical potentialities were put to use.

Why did this happen? Analysis of World War II experience suggested two improvements in the Army's photographic organization.

One was to correct a handicap caused by limited availability of photographic personnel. With cameramen assigned to higher headquarters, broken into small teams and spreading themselves over combat zones that encompassed thousands of square miles, they simply could not always be where a given field commander needed them.

A second handicap developed out of incomplete control by a field commander over those cameramen who were ordered to his sector for a particular operation. Photographers were asked to perform two missions: that of the higher headquarters to which they were assigned, and that of the



Photographer briefs liaison plane pilot on area to be photographed and at what altitude. Italy, December 1944.

smaller unit to which they were attached. This in itself was difficult enough, but in addition most of their pictures had to be processed at higher headquarters laboratories which were far from the front. When the field commander got his pictures, he might already have completed the operation they were intended to assist.

Division Photo Companies

Thus from World War II experience was formed the basis of new Army doctrine which calls for photographers as part of the organic troops of the division. Under T/O&E 11-7N, published May 3, 1948, and gradually being implemented, there will be a photographic section in the division signal company. This will be true of airborne and armored divisions, as well as infantry. These photographers and their equipment—including darkrooms—always will be with the division. They will be under the direct control of the division commander, always available for tactical work. To him, photography will be a weapon, a weapon that is most effective when used with speed, before tactical situations change.

In addition to the division photographic troops there will be the same signal photographic companies and combat teams that carried the load in World War II. They will make the pictures for press and posterity, for strategic analysis and troop training. They will make tactical pictures, too, whenever they can.

Division photographers will make both still and motion pictures. Those that are needed by the division commander will be processed in mobile field laboratories.

The photographic section of the division signal company will have, among its equipments, two complete darkrooms; six press-type cameras, unless replaced by new equipment that will be described presently; six 35mm still cameras; one 35 mm motion picture camera; 12 sound motion picture projectors (16mm); and five film strip and slide projectors.

Long-Range Photo Projects

This is some of the equipment T/O & E 11-7N now calls for, but radical changes are in the offing. For the Signal Corps has initiated a two-pronged attack on the photographic problems developed in World War II. One is the doctrine just described, the provision of photographic troops as an organic part of the division. The other is taking place in the Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey. It is there that engineers think about expendable one-shot cameras with plastic lenses. It is there that they are thinking a great many other photographic thoughts.

Today the Signal Corps has a long-range engineering development plan covering virtually every aspect of still and motion picture photography in the Army. Projects are in various stages of development, with some equipments built, some borrowed from industry and modified, some still being dreamed of. The Signal Corps is not ready to go into mass production on all these items, by any means. But here is the plan, here is the pattern of post-war thinking by photographic engineers.

Basic Camera, Semi-Automatic

Four types of still cameras are being considered for tactical work. Basic among these may be a rugged, spring-driven, roll film camera using 70 mm (nearly three inches wide) perforated film in magazines containing up to 60 exposures. Shutter speeds will range from bulb to one five-hundredth of a second. There will be a built-in flash synchronizer and built-in combination view finder and range finder. It will have a series of interchangeable lenses. The camera will be semi-automatic, so that a single winding will make it possible to shoot up to six pictures as rapidly as the operator can press the shutter release. Two models of this camera currently are undergoing technical tests at Fort Monmouth.

A simplified version of the rugged 70mm camera is being considered for front-line, combat use. All versatility features would be eliminated to make operation easier, reduce weight, and minimize maintenance. It probably would be equipped with one lens only and extremely limited shutter speeds, perhaps just one twenty-fifth

A.P.S. photographers recorded front line action of WW II. A parachute drop on Corregidor ...

and one one-hundredth of a second. It would be designed for strength and simplicity.

Then there is the expendable 70mm camera already mentioned. If developed according to present thinking, it would be of cardboard or similar material, and collapsible so that a great number of troops could carry them in their pockets, shoot a quick picture of anything that seemed of battle value. With a cheap plastic lens, and intended to make but one picture, these cameras could be destroyed after serving their purpose.

The Signal Corps also has a winterized 35mm miniature camera which is a modification of a commercial type and can be used for still pictures of tactical value.

Infra-red Telephotos

Still pictures for reconnaissance and for strategic study probably will be made with the four cameras just described and several others, among them a long-range camera using infra-red films and covering at least 30 miles. Such a camera is under development. There also is contemplated a medium long-range camera, probably with a 20-inch lens, which will produce a finished picture in about one minute. This also is under development.

Special Purpose Cameras

Strategic and reconnaissance work also may be aided by a stereoscopic camera, in all probability a modification of the 70mm camera. Two images will be obtained by the optical arrangement of the camera, and their proper projection to get a third dimensional effect will be obtained by modification of existing still picture projectors. This work now is under development.

New equipment for identification work — where mass production is required, such as processing prisoners of war — also is contemplated under the Signal Corps photographic development plan, but work on the project has not yet begun. Such equipment might make front and profile views of the subject simultaneously, the trick being done with mirrors and prisms. It is hoped that this equipment in addition can be made to record essential data, such as name, rank and serial number; and also take finger "prints" without actually inking and printing the hands, but by photographing the grain of the skin.

Special cameras for specialized jobs in the Army likewise have a place in the engineering plan. Equipment will be required for intelligence, for research and development activities, and for historical and documentary purposes. In many instances, cameras built primarily for other activities will serve equally as well for

... shelling retreating German forces in France

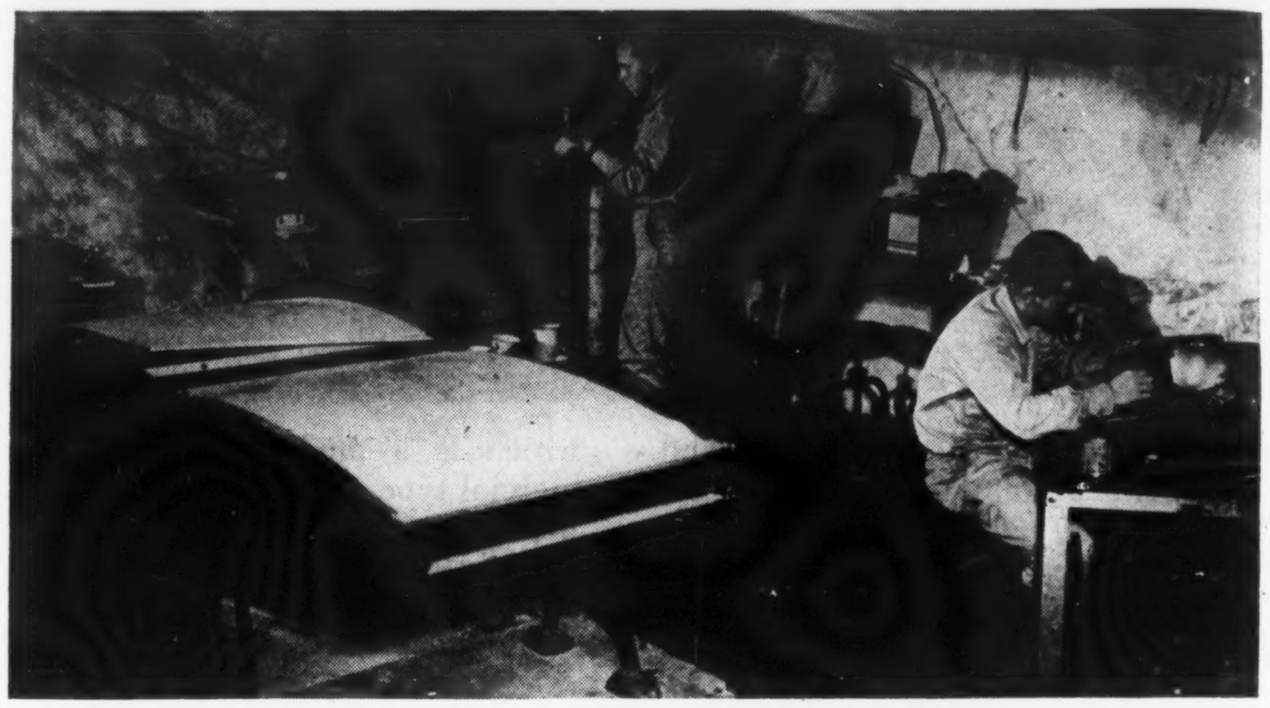
... smoking out Japanese on Kwajalein.

these. But they will be supplemented with special equipment.

Signal Corps thinking is not limited to cameras. There is contemplated, for example, mobile and rapid processing equipment with water-conservation features. Where water in the field is scarce, this equipment would make possible its reclamation and reuse. Thus, perhaps, a mobile darkroom might be operated with just 10 gallons of water. This development is well under way, and research also is seeking to improve an electrographic process which would not require water at all.

New scene-lighting equipments are being considered. Where electricity is not available, the flame of a torch may be used to heat a special substance to incandescence. Flash equipment may be designed to operate on a generator, for use in extreme cold where batteries will not function. Electronic flash equipment, using gas discharge lamps, is being studied for military use.

Mobile Photographic laboratory and truck, Milne Bay, New Guinea. 1943.



Finishing room of mobile laboratory.

Light-weight Movie Cameras

In the motion picture field, frontline tactical pictures probably will be made with a light-weight, hand-held, rugged 35mm camera, operated by batteries and carrying a 200-foot roll of film. It will have a series of interchangeable lenses, but a single view finder which will be adjustable to match the particular lens in use. Also contemplated for combat motion picture photography is a light-weight, rugged, hand-held 16mm camera.

For making training films — a major Signal Corps activity that will be the subject of a subsequent article — there will be a semi-portable 35mm sound motion picture camera; commercial types of 35mm sound motion picture cameras for permanent installations; and a 16mm sound semi-portable motion picture camera that probably will be used for color work.

As in the still field, special equipments will be designed for specialized jobs, especially in research and development. These are likely to include a motion picture camera for recording instruments that provides automatically controlled exposures in a single frame or sequence of frames; a motion picture camera without conventional shutter, operating at extreme speeds — the so-called "streak camera"; stereoscopic motion picture cameras to produce a third dimensional effect; and cameras for photomicrography.

Mobile processing equipment for both 35mm and 16mm motion picture films is under development. So also is improved 16mm portable projection equipment, so that its quality will more nearly approximate that of standard 35mm equipment. It is expected to achieve this first through improved optics, later through a new lighting method. Models of these projectors now are undergoing technical tests.

That is part of the story — doctrinal and developmental — of photography in the Army. It leaves much unsaid, however, for while the Signal Corps does most of the Army's photography, some other branches conduct specialized activities of their own. Nor have all of the widespread photographic functions of the Signal Corps been told by any means. There is the production of training films, with millions of feet a year pouring from the Signal Corps Photographic Center at Long Island City, New York, into a worldwide chain of film libraries. There is a still picture library of more than half a million subjects, beginning with Matthew Brady's photographs of the Civil War. General Pershing contributed pictures to it, when he was a captain and a military attaché with the Japanese in the Russo-Japanese war. There is the story of the first color picture transmitted from Potsdam to Washington by radio facsimile; and another story in the color laboratories themselves at the Pentagon.

There are too many stories in the Army Pictorial Service to tell them all at one sitting.

For it is the Army Pictorial Service Division of the Office of the Chief Signal Officer that knits together the manifold photographic activities of this modern Army. Almost every time a shutter clicks today among American troops throughout the world, the APS makes another page in its long pictorial history. The man behind the camera probably was trained at the Signal Corps Photographic School, now at Fort Monmouth. His camera was tested and chosen by engineers who also are at Fort Monmouth. Signal Corps supply activities assure him equipment, film, paper and chemicals. If he makes motion pictures, they may furnish a realistic sequence in the next training film APS will produce at the Signal Corps Photographic Center on Long Island — and he may ultimately see his shots in a Signal Corps film library on some other island half way around the world.

ERRORS IN CALIBRATION OF THE *f* NUMBER

By Francis E. Washer
National Bureau of Standards, Washington, D. C.

Summary — **The present system of marking the diaphragm stops in terms of the geometric *f* number is subject to serious deficiencies so far as uniform performance for lenses set at the same marked stop opening is concerned. Decisions regarding the proper exposure time to use at a selected stop opening may be in error by ±10 per cent for a lens whose surfaces do not have antireflection coatings, and by even greater amounts for a lens whose surfaces do have antireflection coatings. These errors arise from differences in the reflection and absorption losses in the lens elements themselves, departures of the measured from the nominal focal length, and departures of the measured diaphragm openings from the nominal diaphragm openings.**

A method is described whereby a lens can be calibrated by a light meter in terms of an ideal lens so that the variation in axial illumination in the focal plane need not exceed ±2 per cent in using different lenses set to the same calibrated stop opening.

In problems of photography where the accuracy of lens markings is critical in determining the proper exposure, the various errors to which these markings are subject is of considerable interest. The present report gives the magnitude of such errors that were found to exist in a representative group of 20 lenses having focal lengths that range from ½ to 47.5 inches. In addition, the results of calibration of these lenses by a photometric method that permits compensation of light losses resulting from absorption, reflection, and scattering are given. Values of lens transmittance for these lenses are shown. A method of plotting results of nominal, true, and calibrated *f* numbers is given that permits quick evaluation of the magnitude of the over-all error in terms of fractions of a stop.

With the advance of photographic technology, a need has developed for more precise information on the light-transmitting characteristics of photographic objects. In particular, a specific need exists for a more accurate means of marking or calibrating the lenses which employ a variable stop for adjusting the lens speed. The usual method, at present, of calibrating a lens is to inscribe a scale of *f* numbers on the diaphragm control. These *f* numbers are based upon certain geometric properties of the lens, and neglecting errors of marking, provide a satisfactory means of varying the speed of the particular lens by definite integral steps. Unfortunately this system of marking takes no cognizance of differences in light-transmitting properties that occur among different types of lenses and in addition those differences that result between lenses of the same type when the surfaces of one have been treated to reduce reflective losses.

This problem has been under vigorous attack for the past ten years and numerous methods have been devised for the rating of lens speed with respect to some standard. These methods differ in such matters as type of light source, comparison lens or standard aperture, and type of light-registering device. The theoretical aspects of the problem have been discussed by McRae and by Gardner who proposed several possible methods for calibration of a lens. In the present article, one of the methods described by Gardner is verified experimentally. The experimental technique is described and the variations in performance for 20 lenses, having focal lengths that range from 0.5 to 47.5 inches, are shown. Attention is given to sources of error in the existing marked *f* number. Lastly, a process is described for determining the transmittance of a lens from data obtained in the source of calibration.

Measurement Method

The apparatus consists essentially of a broad uniform source of white light, a sensitive light-measuring device, and a holder which can be used interchangeably either for mounting the lens under test or one of a series of standard diaphragms, each of which has a centrally located circular opening of known diameter. The arrangements of these elements is the same as that suggested by Gardner. The relative lens speed is determined by a comparison of the quantity of light flux transmitted by a lens with that transmitted by a circular opening. By making an appropriate series of measurements and by proper interpretation of their significance, the lens can be calibrated in terms of an "ideal" lens having 100 per cent transmittance.

A lens is mounted in the holder and its axis is aligned with the center of the broad uniform source and the center of the small circular opening in the baffle covering the sensitive element of the light-measuring device. The front of the lens faces the light source and the distance separating

To the professional photographer the basis of Mr. Washer's exposition should be nothing startlingly new. There has been a considerable study of lens light transmission in the past decade and several reports have been published on the findings of those studies.

For the average amateur, who does not likely follow laboratory tests and reports, it must come as an unpleasant surprise to learn that his careful light measurements and lens settings have been in vain as to thorough accuracy.

For professional and amateur alike Mr. Washer's discourse should be of interest. He summarizes findings, presents a solution and the technique by which the answer was obtained.

Mr. Washer's paper was published as Research Paper #1927, October 1948 issue, Vol. 41, #4, National Bureau of Standards. It was also published by the Society of Motion Picture Engineers.

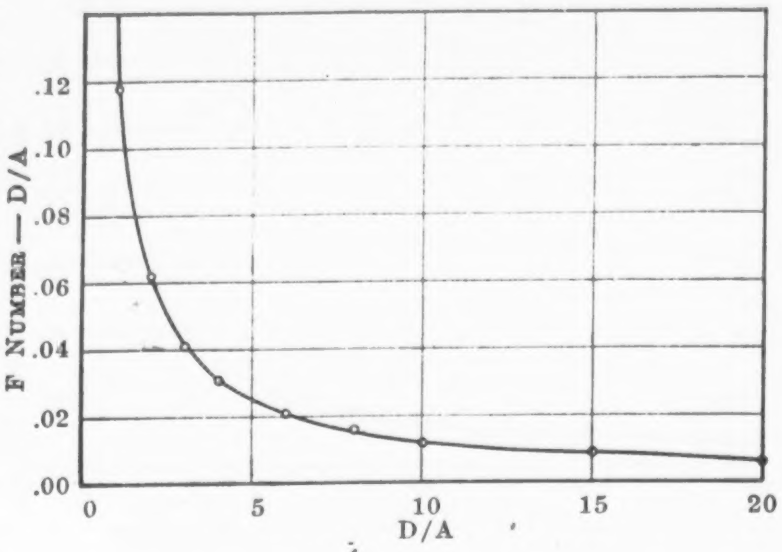


Fig. 1—Calibration curve for computing f number of standard diaphragms when the value of D/A is known.

the rear nodal point of the lens and the baffle covering the light-sensitive element is adjusted to equality with the equivalent focal length f of the lens. The opening in the baffle does not usually exceed 1 mm except for some lenses of very long focal length in which cases it is kept under 0.01 f. All parts of the equipment are shielded so that only light from the source that passes through the lens can reach the light-sensitive element.

Readings of the light meter are taken at each of the marked stop openings. To minimize error arising from backlash, readings are taken both for the condition of the setting at the marked f number being made with the diaphragm ring of the lens moving in the closing direction and with the diaphragm ring moving in the opening direction.* The readings from these two sets of observations are averaged and this value is taken as the accepted reading of the light meter at a given marked stop opening.

The lens is replaced by one of the series of standard diaphragms which have centrally located circular openings with known diameters. The reading of the light meter is taken and the distance D, from the diaphragm to the baffle covering the light-sensitive element, is measured. This operation is repeated for several of the standard diaphragms so selected that readings of the light meter are obtained throughout the same range of readings that were observed for the various marked apertures of the lens. The brightness of the source and the sensitivity of the light meter are kept unchanged throughout both parts of the experiment. To ensure constancy of brightness of the source, a constant-voltage transformer is used to maintain a constant voltage for the lamps that illuminate the broad uniform source. To minimize error, two sets of data are taken for both the lens and the series of standard diaphragms so intermingled that random fluctuations in the brightness of the light source and in the sensitivity of the light meter can be neglected.

Ideally the diameters of the standard diaphragm openings should be so chosen that the same series of f numbers are present in both phases of the experiment. Too, the distance D should equal the equivalent focal length f of the lens. In practice, however, it has proved to be more convenient to let D differ from f and to place more reliance upon the ratio D/A, where A is the diameter of the circular opening in a standard diaphragm. When a wide variety of lenses is being calibrated, as is the case in this experiment, it is simpler to compute the f number of the standard diaphragm from the ratio D/A and to determine the performance for the conventional series of f numbers from the curve of light-meter reading versus f number rather than to attempt to reproduce the conventional set of f numbers by appropriate selection of values of D and A.

The f number for a lens is defined by the equation

$$f \text{ number} = \frac{1}{2 \sin \alpha} \qquad (1)$$

where α is the angle between the axis and the extreme ray of the circular conical bundle transmitted by the lens. In the case of the standard diaphragm, the relation connecting the measured quantities D and A is

$$\frac{D}{A} = \frac{1}{2 \tan \alpha}. \qquad (2)$$

Accordingly the values of the f numbers for the standard diaphragms can readily be computed from the known values of D/A. A sufficiently accurate determination of the f number can be made with the aid of a curve such as is shown in Fig. 1. To produce this curve, the values of the quantity, f number, D/A, are plotted as a function of D/A. Hence, for a given value of D/A, the increment that must be added thereto to yield the f number can be read easily from the graph. For values of D/A greater than 15, the values of D/A and f number are equal for all practical purposes since their difference is less than 0.1 per cent.

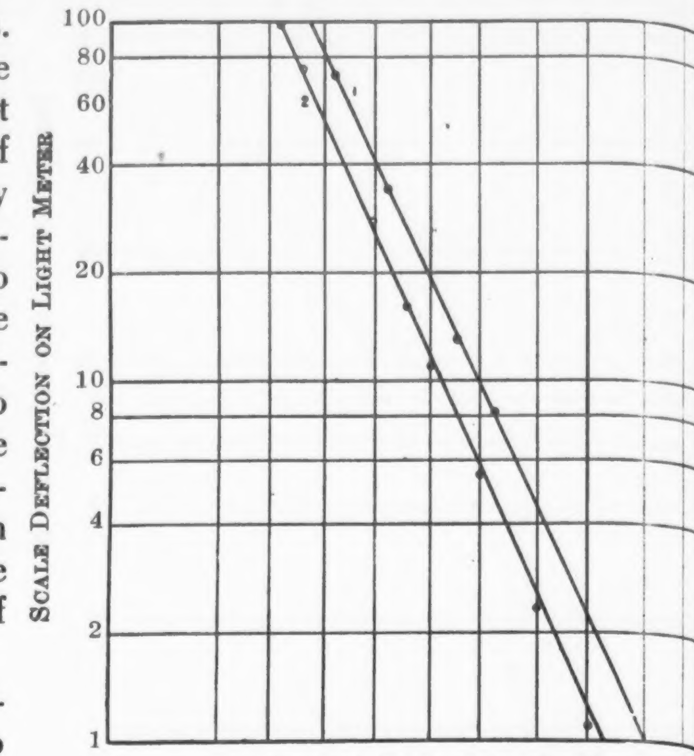
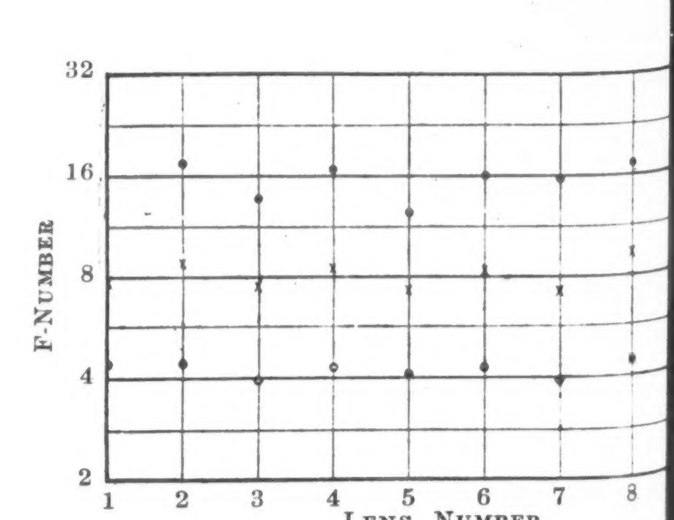


Fig. 2—Scale deflection on light meter versus f number. Curve No. 1 is for the standard diaphragms. Curve No. 2 is for the lens under test.

When the values of the scale deflections of the light meter are plotted against the f numbers of the standard diaphragms on logarithmic paper, the resulting curve is a straight line with a slope nearly equal to 2. The fact that the slope is not exactly 2 may be attributed to a slight departure from linearity of the response of the light meter to varying amounts of light indicated on the receiver. This curve, shown as curve 1 in Fig. 2, shows the relation between the scale deflections of the light meter and the f numbers of an ideal lens.

In a like manner, the values of the scale deflection of the light meter are plotted against the f numbers of the

Fig. 3—Departure of the calibrated f number from the marked f number at $f/4$, $f/8$, and $f/16$ for 10 lenses. The line separations are equal to one stop opening.



*Ten lenses (Nos. 10, and 12 to 20, inclusive) were calibrated in this manner. The remaining ten lenses were calibrated with the diaphragm ring moving in the closing direction only in accordance with the recommendation contained in Report No. 6 of the Subcommittee on Lens Calibration of the Society of Motion Picture Engineers on November 6, 1947.

TABLE I

MEASURED VALUE OF THE CALIBRATED f NUMBER FOR EACH VALUE OF THE MARKED f NUMBER FOR EACH OF 20 LENSES HAVING FOCAL LENGTHS THAT RANGE FROM 0.5 TO 47.5 INCHES

Marked f Number	Lens Number																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Nominal Focal Length in Inches																			
	0.5	0.5	1.0	1.4	1.6	2.0	2.0	3.0	3.0	3.0	4.0	7.0	7.5	11.0	13.5	16.5	19.0	24.0	30.0	47.5
	Calibrated f Number																			
1.9	2.40		2.09																	
2.2							2.23													
2.3									2.45											
2.5		2.82									2.79									
2.7				3.14	3.14	3.09														
2.8	3.25	3.13	2.86				2.79	3.20	2.96		3.00									
3.0										3.68										
3.5										4.26										
4.0	4.42	4.45	3.92	4.33	4.10	4.36	3.95	4.48	4.07	4.85	4.24									
4.5													5.60							
5.6	5.32	6.32	5.52	5.82	5.46	6.00	5.29	6.22	5.78	6.74	5.76		6.86							
6.8										8.68		8.00								
7.5															9.72					
8.0	7.80	8.78	7.50	8.48	7.37	8.37	7.26	8.72	8.33	10.4	8.33	9.32	9.75	10.1						
9.5																12.3				
11.0	11.0	11.8	9.94	12.5	9.66	11.6	11.2	12.3	11.4	14.4	11.1	13.1	13.6	13.9	14.1	13.4	13.6	14.3		
12.5																			15.6	
15.0																				16.0
16.0	15.4	17.2	13.6	16.8	12.3	16.0	15.7	17.4	17.4	21.5	15.4	18.7	18.3	19.7	19.8	19.5	19.2	19.8	19.3	17.3
22.0	21.3			24.2	16.0	21.9	20.4	24.5		33.6		25.2	24.0	28.0	28.4	26.8	25.8	28.2	26.7	23.3
32											27.6	36.7	29.5	37.0	40.0	38.0	37.6	40.9	39.2	34.7
45												49.0			56.9	52.8	50.8	59.9	53.4	48.6
64															76.0	71.8	69.6	86.8	79.0	71.1
90																100.0	98.0	117.0	99.0	97.6
128																				143.0

TABLE II

SETTINGS OF THE STOP OPENINGS IN TERMS OF THE MARKED f NUMBER TO YIELD A SERIES OF CALIBRATED f NUMBERS CORRESPONDING TO 100 PER CENT TRANSMITTANCE FOR EACH OF 20 LENSES HAVING FOCAL LENGTHS THAT RANGE FROM 0.5 TO 47.5 INCHES

Calibrated f number	Lens Number																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Nominal Focal Length in Inches																			
	0.5	0.5	1.0	1.4	1.6	2.0	2.0	3.0	3.0	3.0	4.0	7.0	7.5	11.0	13.5	16.5	19.0	24.0	30.0	47.5
	Setting Terms of Marked f Number																			
2.8	2.33	2.48	2.74	2.38	2.27	2.42	2.81	2.42	2.62		2.51									
4.0	3.58	3.60	4.08	3.63	3.83	3.63	4.05	3.56	3.91	3.27	3.76									
5.7	5.92	5.10	5.80	5.47	5.78	5.33	6.02	5.10	5.50	4.67	5.55		4.62							
8.0	8.10	7.24	8.57	7.56	8.86	7.75	8.63	7.32	7.75	6.26	7.72	6.80	6.60							
11.3	11.3	10.5	12.7	10.2	13.8	10.7	11.3	10.3	10.8	8.90	11.2	9.60	9.23	9.04	8.80	8.60				
16	16.4	14.9	19.1	15.1	22.0	16.0	16.5	14.6	14.9	12.2	16.7	13.6	13.4	12.8	12.7	13.1	13.2	12.4	12.8	14.6
22.6	23.2			20.6	35.3	22.7	24.8	20.5		16.6	24.7	19.3	20.6	18.2	18.0	18.6	19.2	18.2	18.8	20.6
32											38.1	27.9	36.4	26.2	25.3	26.9	27.4	25.2	26.2	29.0
45												40.5		39.8	35.6	38.2	39.3	35.1	37.3	41.0
64															51.8	56.3	58.6	47.8	53.0	58.2

actual lens on the same curve sheet. The resulting curve, designated curve 2 in Fig. 2, is a straight line parallel to curve 1 but displaced laterally therefrom. This displacement shows in a striking manner the effect of light losses in the actual lens. A fairly close approximation of the relative light transmission of the actual lens at a given f number can be made at once, as it is simply the ratio of the ordinates of curve 1 and curve 2 for the given f number.

It must be mentioned that while curve 1 is always a straight line, this is a consequence of its accurately determined f numbers. On the other hand, the f numbers for curve 2 are read directly from the lens markings and are subject to a variety of errors that will be discussed later in the paper. As a result of these random and systematic errors the points for curve 2 sometimes do not fall as close to the straight line drawn as could be desired. This is especially noticeable at the small apertures associated with the large f numbers. However, these variations in no way interfere with validity of the final results but are in fact helpful in tracking down errors in the f numbers.

The values of the calibrated f numbers for the actual lens may be obtained readily from these curves. The calibrated f number is a term used to designate the f number of an ideal lens (i.e., a lens having 100 per cent transmittance) transmitting the same amount of light that is transmitted by the actual lens at a given marked f number. The terms T-aperture ratio or T stop and equivalent-aperture ratio are other designations of this same quantity. To determine the calibrated f number, the value of the scale deflection for a given marked f number of the actual lens is noted and the value of the f number of the ideal lens for which the same scale deflection is obtained is read from curve 1. This has been done for twenty lenses covering a wide range of focal lengths and f numbers. The results are listed in Table I.

The unusual values of marked f numbers which are listed in the first column result from assigning a calibrated f number to the maximum stop opening for each lens. The maximum stop opening of a lens quite frequently does not fall in the commonly accepted series of marked f num-

Table III

Ratios of Relative Illumination in the Axial Region of the Focal Plane for Lenses Used under Identical Lighting Conditions, Settings Being Made with the Diaphragm Control Moving to Close and with the Diaphragm Moving to Open the Lens

Nominal Focal Length, Inches	Nominal f Number	Ratio of Light Transmissions Diaphragm Closing to Diaphragm Opening: Planimeter, Ac/Ao	Light Meter, Lc/Lo	Weighted Average
16.5	9.5	1.01	1.04	1.03
	11	1.01	1.02	1.02
	16	1.02	1.04	1.03
	22	1.02	1.07	1.06
	32	1.05	1.11	1.10
	45	1.13	1.08	1.09
	64	1.11	1.08	1.09
19.0	11	1.00	1.00	1.00
	16	1.06	1.02	1.03
	22	1.05	1.04	1.04
	32	1.07	1.06	1.06
	45	1.10	1.09	1.10
	64	1.24	1.26	1.26
24	11	1.00	1.00	1.00
	16	1.00	1.03	1.02
	22	1.05	1.05	1.05
	32	1.02	1.11	1.09
	45	1.09	1.14	1.13
	64	1.06	1.18	1.16
30	12.5	0.99	1.01	1.00
	16	1.04	1.03	1.03
	22	1.02	1.02	1.02
	32	1.04	1.06	1.05
	45	1.08	1.02	1.03
	64	1.08	1.07	1.07

bers although the remaining marked f numbers of the lens usually do. The calibrated f numbers, in most instances, are larger than the marked f numbers. This is as expected because it is known that some of the light incident on the front surface of a lens is lost as a result of reflection back in the object space or by absorption in the glass. The considerable differences in the calibrated f numbers for a given marked f number indicate appreciable differences in the light-transmitting qualities of the various lenses. This is illustrated in Fig 3 where the calibrated f numbers are plotted on semilogarithmic paper for ten lenses. The values are given for the marked f numbers, 4, 8, and 16. Departures as great as ⅓ stop opening are indicated in many instances. Since the departures may be in either direction from the marked stop opening, it is possible to select two lenses such that, on using each for the same scene at the same marked stop opening, the effective difference in exposure is equal to that produced by a change in excess of one full-stop opening. The fact that some lenses have calibrated f numbers less than the marked stop opening may seem anomalous in that it indicates a transmittance greater than unity. This is, however, for the most part, an indication of errors in the marked stop opening and will be discussed in more detail in a later section.

Lens No. 7 is of especial interest in that the indicated stop openings are marked in T stops, consequently the values of the calibrated f numbers are quite close to the marked f numbers. Lenses Nos. 2, 3, 7, 9, 11, and 20 have coated surfaces to reduce reflection losses. The gain in transmittance is definitely present but is somewhat obscured in Table I because the marked aperture ratios frequently differ from the true geometric-aperture ratio.

The fact that the calibrated f number varies so much from lens to lens for the same nominal f number gives support to the proposition that all lenses should be so marked that differences in light-transmitting properties are negligible for a given f number. This can be done from the curves shown in Fig. 2, by reversing the procedure used in deriving the information reported in Table I. The deflection of the light meter for a given f number of the ideal lens is noted on curve 1 and the f number of the actual lens which will yield the same deflection is read from curve 2. This can also be done by plotting the calibrated f number for a lens listed in Table I against the marked f number on logarithmic paper. The marked f number for a given calibrated f number can then be read directly from the graph. This has been done for the same 20 lenses and the results are listed in Table II. This table shows the proper settings in terms of the marked f number so that each of these lenses will yield uniform performance for each of a series of calibrated f numbers.

In addition to the light losses in

Table IV

Comparison of Nominal and Measured Values of Equivalent of Focal Length and Effective Aperture for a Representative Group of Lenses

Lens No.	Equivalent Focal Length Nominal, Mm	Measured, Mm	Difference in Equivalent Focal Length, Per Cent	Effective Aperture Nominal, Mm	Measured, Mm	Difference in Aperture, Per Cent
1	12.5	12.35	−1.2	6.58	7.07	+7.4
2	12.5	12.99	+3.5	5.00	5.07	+1.4
3	25.4	25.56	+1.0	13.37	13.65	+2.1
4	35.0	37.50	+7.1	12.96	14.06	+8.5
5	40.0	42.08	+5.2	14.81	14.94	+0.9
6	50.0	51.39	+2.8	18.52	19.62	+5.9
7	50.8	50.62	−0.4	25.40	24.40	−3.9
8	75.0	75.31	+0.4	26.78	27.36	+2.2
9	75.0	75.02	0.0	32.61	32.58	−0.1
10	76.2	74.71	−2.0	25.40	24.60	−3.2
11	101.6	99.42	−2.1	39.53	40.64	+2.8
12	177.8	180.81	+1.8	26.15	26.15	0.0
13	190.5	190.53	0.0	42.34	40.17	−5.1
14	279.4	284.85	+2.0	34.92	35.74	+2.3
15	342.9	351.6	+2.5	45.72	42.21	−7.7
16	419.1	418.14	−0.2	44.12	41.30	−6.4
17	482.6	481.97	−0.1	43.87	43.29	−1.3
18	609.6	605.55	−0.7	55.42	51.40	−7.2
19	762.0	756.54	−0.7	60.96	59.14	−3.0
20	1206.5	1207.60	+0.1	....	....	....

TABLE V

NOMINAL AND MEASURED VALUES OF THE f NUMBER FOR A REPRESENTATIVE GROUP OF LENSES

Lens Number	Nominal Focal Length, Mm	f Number Nominal	f Number Measured	Error in f Number, Per Cent	Relative Transmittance
1	12.5	1.9	1.77	−6.8	1.15
2	12.5	2.5	2.62	4.8	0.91
3	25.4	1.9	1.87	−1.6	1.03
4	35.0	2.7	2.67	−1.1	1.02
5	40.0	2.7	2.82	4.4	0.92
6	50.0	2.7	2.62	−3.0	1.06
7	50.8	2.2	2.07	−5.9	1.13
8	75.0	2.8	2.75	−1.8	1.04
9	75.0	2.3	2.30	0.0	1.00
10	76.2	3.0	3.04	1.3	0.97
11	101.6	2.5	2.51	0.4	0.99
12	177.8	6.8	6.91	1.6	0.97
13	190.5	4.5	4.74	5.3	0.90
14	279.4	8.0	7.97	−0.4	1.01
15	342.9	7.5	8.33	11.1	0.81
16	419.1	9.5	10.12	6.5	0.88
17	482.6	11.0	11.13	1.2	0.98
18	609.6	11.0	11.78	7.1	0.87
19	762.0	12.5	12.79	2.3	0.96

the lens arising from absorption and reflection, there are several sources of error that affect the reproducibility in the amount of light reaching the focal plane at a given stop opening. The first of these is backlash in the iris-diaphragm stop and results in differences in light transmission dependent upon the manner in which the diaphragm is set at a given stop opening. The second error is an actual error in the markings themselves and may arise from errors in aperture, errors in equivalent focal length, or errors in both at the same time. The backlash error varies for each lens while the error in f markings contributes to variations in performance when several different lenses are in use for the same type of work.

1. Error in Setting the Lens at a Given f Number

When the diaphragm is set at a given f number, there is an appreciable difference in the amount of light passed by the lens dependent upon the direction of movement of the diaphragm control. The error arising from this source has been investigated and the results are listed in Table III for several lenses. This backlash error is determined by two methods. In the first method, the lens is mounted on a stand and the edges of the diaphragm are illuminated from the rear of the lens by a fixed source. Photographs of the stop opening are made with an auxiliary camera placed in front of the lens. Each stop opening is photographed for the condition of the setting being made with the diaphragm closing and with the diaphragm opening. Prints are made of these negatives and the area of each image is measured with a planimeter. Let the area of the image, taken for the condition when the setting is made by closing the diaphragm, be Ac; and the area of the image for the same stop opening, taken for the condition when the setting is made by opening the diaphragm, be Ao. Then the ratio Ac/Ao is accepted as the ratio of the relative illuminations in the axial region of the focal plane when the lens is used under identical lighting conditions for these two processes of setting the lens at a given f number.

In the second method, the data taken in Section II are treated in such manner as to separate the light-meter readings Lc, taken for the condition of the setting being made with the diaphragm closing, and the light-meter readings for the same stop opening Lo, taken for the condition of the setting being made with the diaphragm opening. Then the rate Lc/Lo is accepted as the ratio of the amounts of light passing through the lens for these two conditions and is comparable to Ac/Ao obtained by the first method.

The values of these ratios are tabulated in Table III for a series of stop openings for four lenses. The differences by the two methods result mainly from the fact that a greater number of sets of data is used in the determination of Lc/Lo. The third column gives the weighted average with a weight of 4 given to Lc/Lo and a weight of 1 given to Ac/Ao. It is noteworthy that this error arising from backlash varies from 1 to 2 per cent at the larger stop openings to as high as 10 to 26 per cent for the smaller stop openings. It is clear that error from this cause can be avoided by always making the diaphragm setting in the same manner, and preferably in the direction of closing the diaphragm.

TABLE VI

NOMINAL AND ACTUAL VALUES OF THE TRANSMITTANCE AT FULL APERTURE FOR A REPRESENTATIVE GROUP OF LENSES

Lens Number	Equivalent Focal Length, Inches	f Number Marked	f Number True	f Number Calibrated	Transmittance Nominal	Transmittance Actual
1	0.5	1.9	1.77	2.40	0.63	0.54
2	0.5	2.5	2.62	2.82	0.79	0.86
3	1.0	1.9	1.87	2.09	0.83	0.80
4	1.4	2.7	2.67	3.14	0.74	0.72
5	1.6	2.7	2.82	3.14	0.74	0.81
6	2.0	2.7	2.62	3.09	0.76	0.72
7	2.0	2.2	2.07	2.23	0.97	0.86
8	3.0	2.8	2.75	3.20	0.77	0.74
9	3.0	2.3	2.30	2.45	0.88	0.88
10	3.0	3.0	3.04	3.68	0.67	0.68
11	4.0	2.5	2.51	2.79	0.80	0.81
12	7.0	6.8	6.91	8.00	0.72	0.75
13	7.5	4.5	4.74	5.60	0.65	0.72
14	11.0	8.0	7.97	10.1	0.63	0.62
15	13.5	7.5	8.33	9.72	0.59	0.73
16	16.5	9.5	10.12	12.30	0.60	0.68
17	19.0	11.0	11.13	13.60	0.65	0.67
18	24.0	11.0	11.78	14.30	0.59	0.68
19	30.0	12.5	12.79	15.60	0.64	0.67

There still remains the random error of making the setting, even if care is taken to move the control always in the same direction. This error is, however, small in comparison to backlash error, and it is believed that it should be negligible for the careful worker at the larger stop openings and perhaps rising to approximately one fourth of the backlash error for the smaller stop openings.

2. *Errors in the Existing Geometrical f Number*

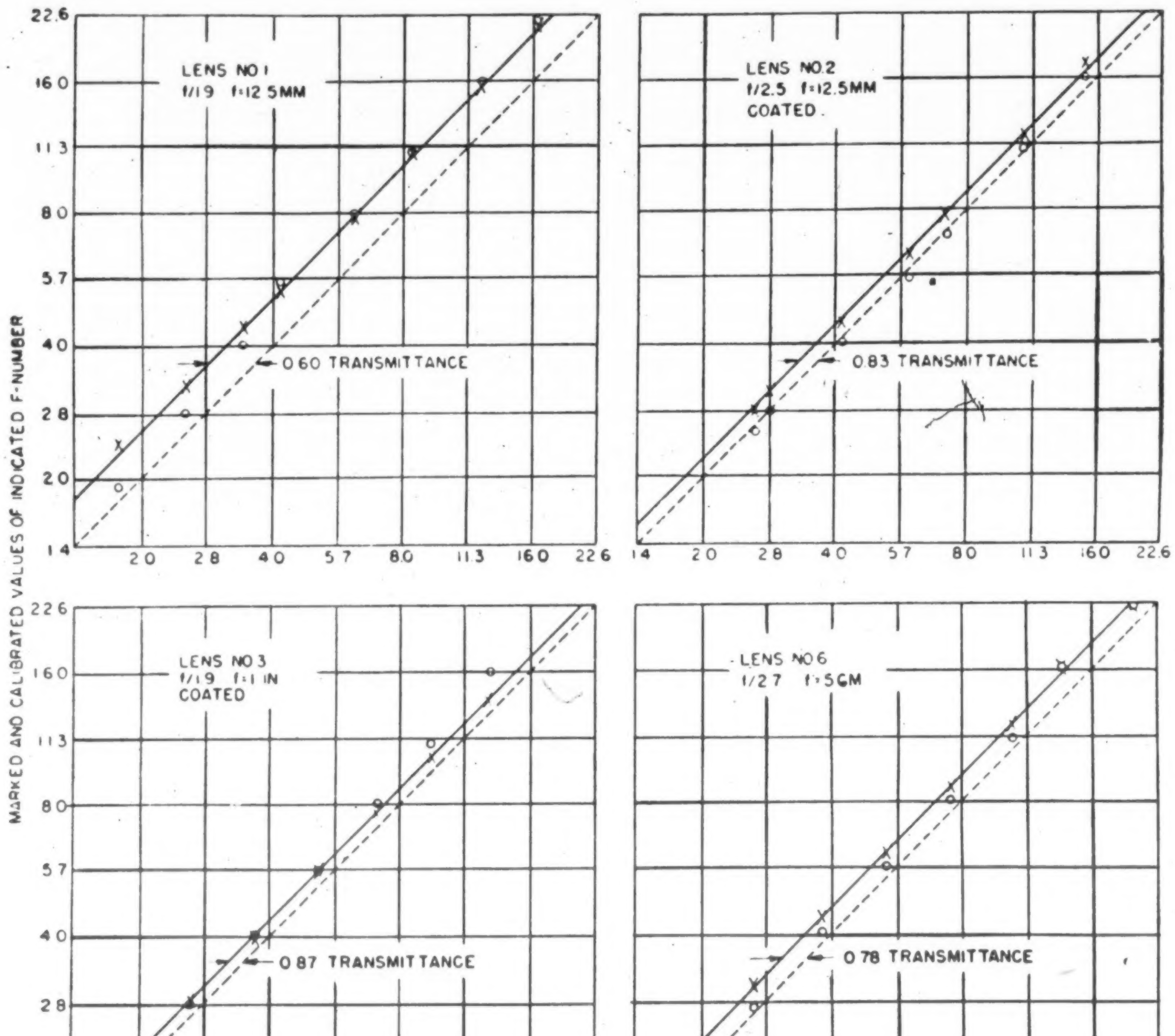
(*a*) *At full aperture* — The true geometrical *f* number is obtained by dividing the equivalent focal length of the lens by the diameter of the effective aperture. It is therefore obvious that errors in the value of the equivalent focal length and the effective aperture will be reflected by errors in the *f* number. Table IV lists the nominal and measured values of equivalent focal length and effective aperture. In those instances, where the nominal focal length was given in inches, conversion has been made to millimeters. The nominal values of effective aperture are computed from the values of nominal focal length and nominal *f* number. Examination of this table shows that the measured value of the equivalent focal length is within ± 2 per cent of the nominal focal length for 15 of the 20 lenses. The average departure for the entire 20 lenses is ± 1.7 per cent. The errors in effective aperture are as high as ± 8 per cent with an average for 19 lenses of ± 4 per cent. Nine of the nineteen lenses show errors in effective aperture in excess of ± 3 per cent. It is doubtful if the errors in focal length can be brought below ± 2 per cent during the process of manufacture but it does seem that the error in aperture at the maximum aperture could also be reduced to ± 2 per cent.

As a result of these departures of the measured values of the equivalent focal length and effective aperture from their nominal values, appreciable errors in the *f* number are produced. This is shown in Table V, which lists the nominal and measured *f* numbers for the same group of lenses. The errors in the *f* numbers range from -6.8 to $+11.1$ per cent. The effect of these errors in terms of relative transmittance is shown in the last column. These values of relative transmittance show that, neglecting losses in the lens, the difference between nominal *f* number and true geometric *f* number may alone produce deviations of as much as 19 per cent between the expected and actual values of the amount of light passed by the lens. It must be emphasized that these differences are present at maximum stop opening where the effective aperture is that of a true circular opening and not that of a many-sided opening which is operative when the aperture is determined by the iris diaphragm. In 6 out of 19 cases, the relative transmittance deviates from unity by 10 per cent or more, which may produce significant differences in exposure time in some instances of use.

(*b*) *Errors in the marked f numbers at reduced apertures* — It is clear that errors of the type described in the preceding section are also present for all of the marked *f* numbers. Because the aperture formed by the usual many-leaved iris diaphragm is a polygon, the accuracy of determining the diameter of the effective aperture is somewhat less than that for the full aperture where the limiting opening is circular. Where the number of leaves is greater than six, two diameters at right angles to one another are measured and the average is considered to be the diameter of a circular opening of the same area. For those diaphragms having four to six leaves, the area is computed from two or three diameters, and the diameter of the equivalent circle is used in computing the *f* number. It is believed that the *f* number obtained in this manner is correct within ± 2 per cent for the small *f* numbers and rising to ± 5 per cent on the average for *f* numbers greater than 22.

The errors in the *f*-number markings for twelve lenses are shown

Fig. 4—Marked and calibrated values of *f* number versus true geometric *f* number. The circles indicate the marked *f* numbers and the crosses indicate the calibrated *f* numbers. The circles would fall upon the dotted diagonal line if marked and true *f* numbers were equal. The crosses would fall upon the dotted line if the transmittance were 100 per cent. The separation of the dotted and solid-line curve gives a measure of the transmittance of the lens. The steps in the net equal one stop opening for ready appraisal of differences in fractions of a stop opening.



graphically in Figs. 4, 5, and 6, where the marked *f* numbers are plotted as ordinates and the true (measured) *f* numbers are plotted as abscissas. The dotted line with slope of unity passing through the origin is the line upon which the marked f numbers would lie if there were no error in the markings. The points are plotted on logarithmic paper so that one may see at a glance what the magnitude of the error is in terms of fractions of a stop opening. For example, in the case of lens No. 3, Fig. 4, the true *f* number corresponding to the *f* number marked 16 is 12.9. This error of marking is clearly shown on the graph to exceed one-half stop. For lens No. 10, Fig. 5, at *f*/16, the true *f* number is 18.4, or more than one-half stop in the opposite direction. For lens No. 12, Fig. 6, the values of marked and true *f* number are very close together throughout the range of the markings.

1. Transmittance at Full Aperture

It is possible on the basis of the information obtained in the course of this experiment to determine the light transmittance of the lens itself. It must be emphasized, however, that the transmittance so determined is the ratio of the amount of light passing through the lens to amount of light incident on the front surface of the lens, and does not differentiate between image-forming and nonimage-forming light. There are two ways of making this determination. The first method yields the nominal transmittance, and is simply the square of the ratio of the nominal *f* number and the ideal *f* number that gives the same deflection on the light meter. Values obtained by this method are listed in Table VI, under the heading of nominal transmittance. Since no cognizance is taken of the errors in the nominal *f* number, the nominal transmittance is affected by the error in *f* number as well as by reflection and absorption losses in the lens.

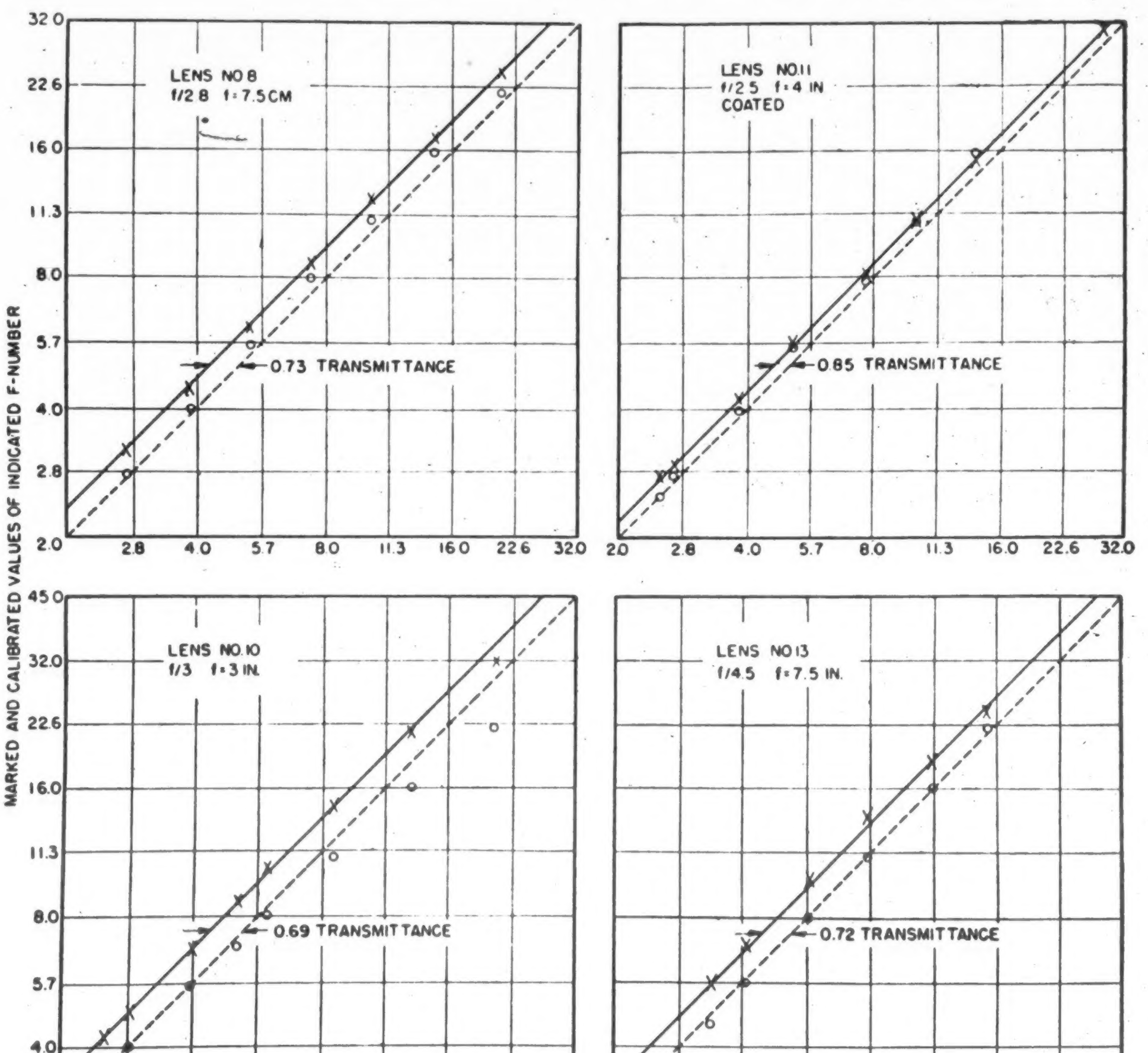
The second method yields the actual transmittance, and is the square of the ratio of the measured and calibrated *f* numbers. Since this method rules out the error in *f* number, the actual transmittance is affected only by reflection and absorption losses in the lens.

It is interesting to consider lenses Nos. 16, 17, 18, and 19. These are all of the same type, having 8 glass-air surfaces but ranging in focal length from 16.5 to 30 inches. The nominal transmittance for these four lenses varies from 0.59 to 0.65, while the actual transmittance is almost invariant, changing from 0.67 to 0.68.

The effect of antireflecting coatings on the lens surfaces can be seen in this table. Lenses Nos. 2, 3, 7, 9, and 11 are coated and all have transmittances which exceed 80 per cent. Only one, No. 5, of the uncoated lenses has a transmittance above 80 per cent and the remaining 13 lenses have transmittances ranging from 62 to 75 per cent with one lens (No. 1) falling as low as 54 per cent. The antireflecting coatings increase the transmittance by 25 per cent or more. Even so, consideration of the actual values of the transmittance shows that 10 per cent or more of the incident light is still lost by the coated lens. This is not surprising when it is remembered that antireflecting films usually yield close to 100 per cent transmittance for only one wavelength of light. Accordingly, when a broad region of the spectrum is covered, as is the case for white light, the transmittance measured is the average for the whole region.

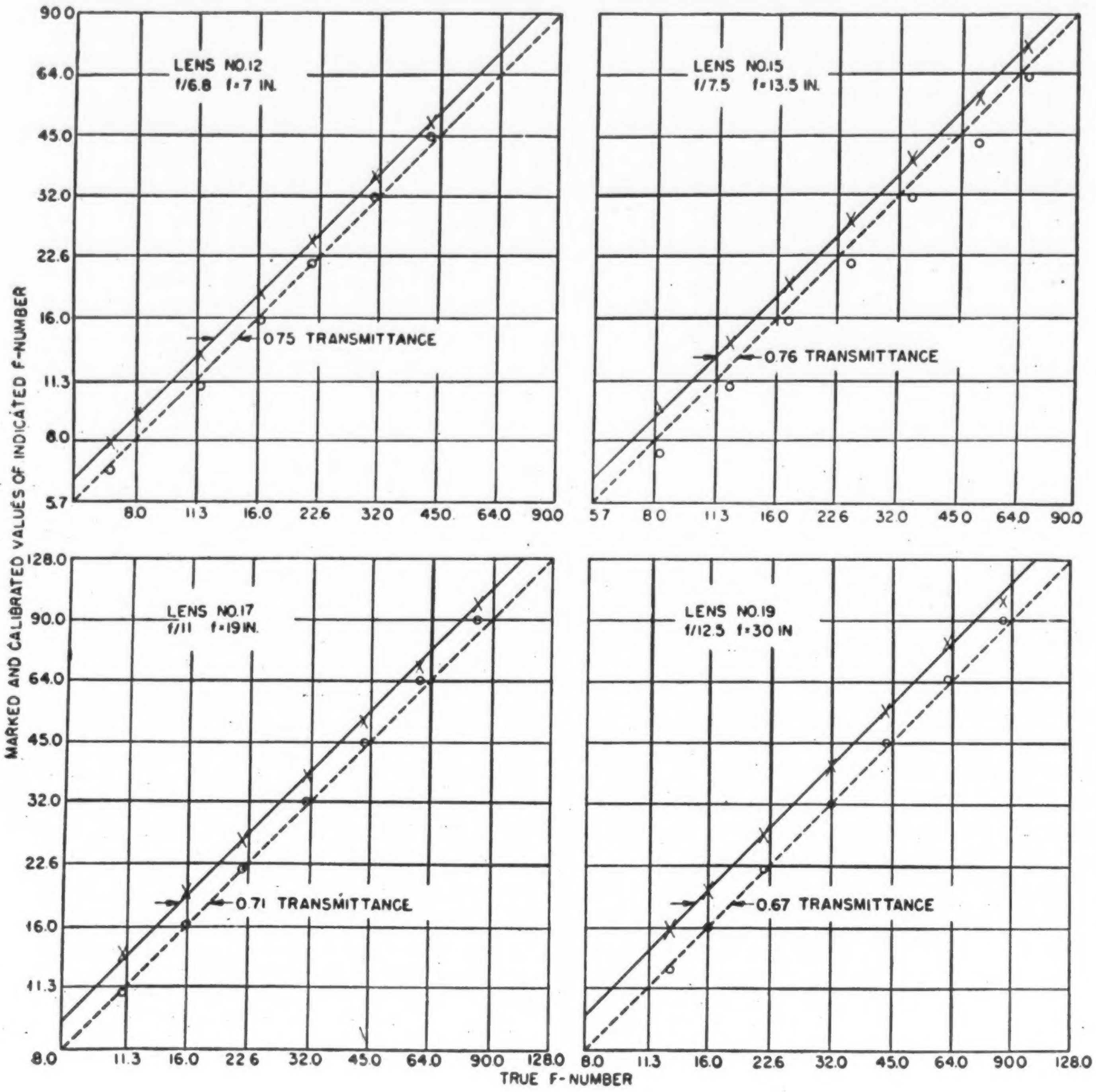
The fact that the values of transmittance obtained by this procedure are affected in some small amount by the presence of nonimage-forming or scattered light cannot be considered as important. It is improbable that markedly different values would be obtained by the use of collimated light incident on the front surface of the lens during the experiment. In any comparison between the broad source method of measuring transmittance or calibrating a lens and the collimated light method, it is unlikely that light scattered by the lens will produce appreciable difference in the end result. The broad source fills the lens with light giving rise to a greater amount of scattered light. However, the diaphragm in the focal plane rigidly restricts the measured

Fig. 5—Marked and calibrated values of *f* number versus true geometric *f* number. The circles indicate the marked *f* numbers. The circles would fall upon the dotted diagonal line if the transmittance were 100 per cent. The separation of the dotted line and solid-line curve gives a measure of the transmittance of the lens. The steps in the net equal one stop opening for ready appraisal of differences in fractions of a stop opening.



scattered light to that falling within a small area. The collimator system, at least for the larger aperture, illuminates the inner surface of the barrel with light at small angles of incidence favorable for reflection. All the light that is scattered and emerges from the lens is evaluated by the detector. *A priori* it is difficult to say which will give the most weight to scattered light. Certainly for a well-constructed lens the differences in results obtained by the two methods will be small. For a lens purposely made to reflect the light from the mount, the result is open to question. However, such lenses do not constitute a threat, because they would not make satisfactory photographs. The extended source does give a measure of the light (some of which is scattered) which will be incident on a central area of the film when a subject is photographed with a reasonably average illumination over the entire field. The collimator method gives a measure of the light available over a central area of the film, plus all scattered light, when a relatively small bright source is photographed on a dark ground.

Fig. 6—Marked and calibrated values of *f* number versus true geometric *f* number. The circles indicate the marked *f* numbers and the crosses indicate the calibrated *f* numbers. The circles would fall upon the dotted diagonal line if marked and true *f* numbers were equal. The crosses would fall upon the dotted line if the transmittance were 100 per cent. The separation of the dotted and solid-line curve gives a measure of the transmittance of the lens. The steps in the net equal one stop opening for ready appraisal of differences in fractions of a stop opening.



2. *Average Transmittance for All Apertures*

The value of transmittance obtained in the preceding section is a reliable one for full aperture, but since a lens is frequently used at a reduced stop opening it is advantageous to consider a method of determining average transmittance throughout the entire range of stops. This is done by plotting the calibrated *f* number against the true *f* numbers as has been done for 12 lenses in Figs. 4, 5, and 6. The crosses show the relation thus obtained. It is clear that these crosses lie on a straight line, shown as a solid line, parallel to the dotted diagonal line. If the crosses should fall on the dotted line it would indicate a transmittance of 100 per cent. As it is, the displacement of the solid line from the dotted line gives at once a measure of the average transmittance for all apertures. This has been computed from the curves and the value of the average transmittance for all apertures is shown for each of the 12 lenses in the proper figure.

It is worthy of mention that this method of plotting the results of measurement serves the dual purpose of showing the consistency of the method of calibration and reliability of the measured values of the true *f* number. Errors in either operation would cause the crosses to fall away from the solid-line curve. The fact that these deviations are small indicates that both calibrated and true *f* numbers have been quite accurately assigned.

From early leisurely depicting of naval scenes, by way of the artist's canvas, to modern use of immediate reproduction, by way of television, employment of the pictorial art and science is in the Navy tradition.

NAVY USE OF THE PICTORIAL ART AND SCIENCE

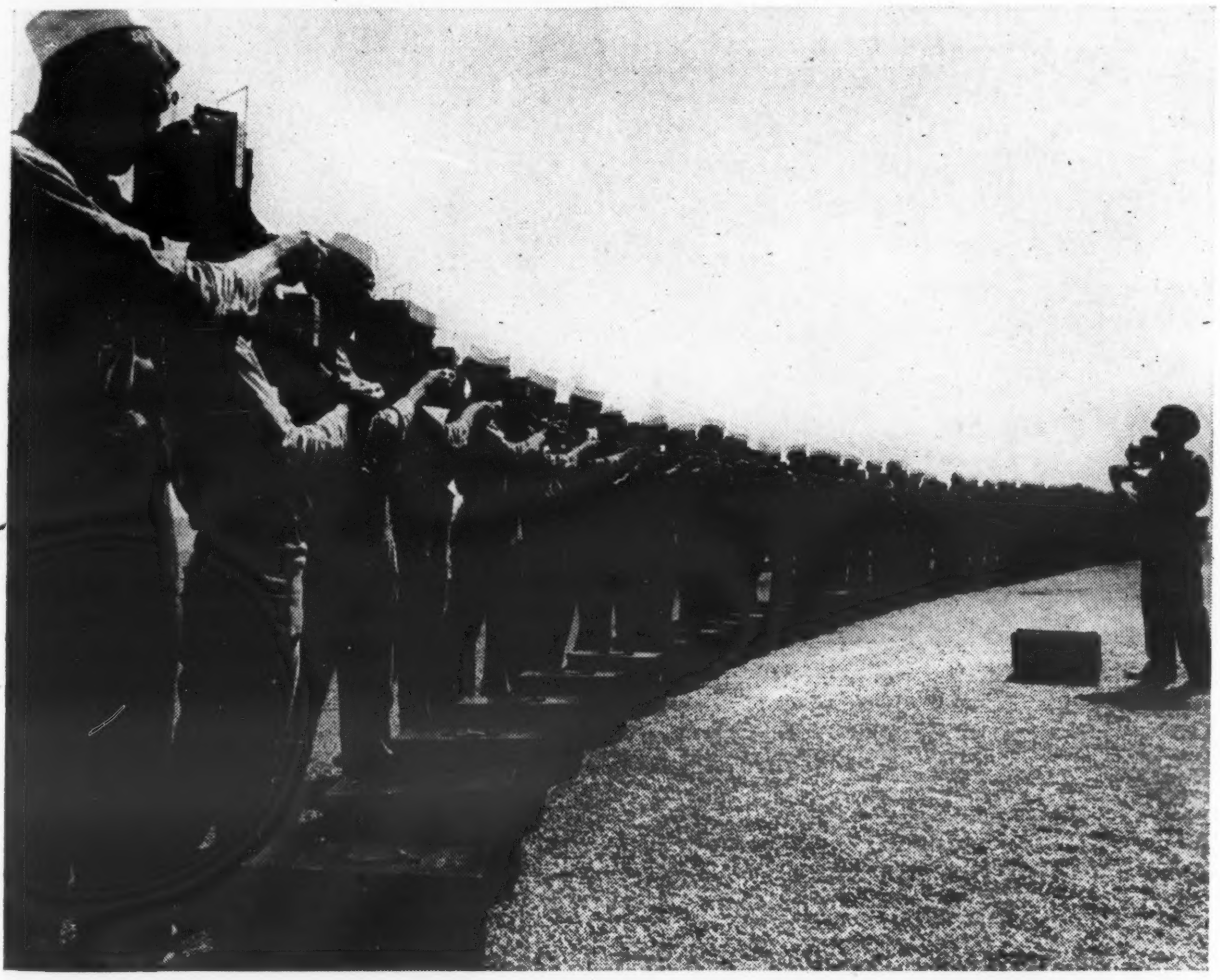
By Bette Evans, Lt. Comdr., USN, Res. and W. Fingal

"I cannot over-emphasize the tremendous importance of pictures to the Navy."

These words were spoken during the early years of the war by the then Secretary of the Navy, the late Frank Knox. But they might have been spoken yesterday or any recent year by any one of thousands of Navy men who have come to value the contribution of the pictorial information medium to the Navy's overall operation.

At the time that Secretary Knox made this statement, he went on to say that this medium served "more varied and vital purposes than most Navy officers and men realized."

But more recent years have brought a better evaluation of the use of pictures to every Navy man. Most of them now realize, as Mr. Knox noted early in the war, that "their first, immediate importance is to provide a report to the American people on who is fighting their battles and how they are being fought. They will," Knox concluded, "preserve for future Americans a graphic and living history of our efforts and sacrifices, made in these trying times to win freedom for the world."



Still camera class U. S. Navy School of Photography, Pensacola, Florida.

Early Pictorial Record

Actually, pictorial records of the U. S. Navy's many memorable engagements go back as far as the history of the Navy itself. The practice of preserving great battles and great victories in pictures is an honored Navy tradition.

But in the past, those records were more often of the pen and brush than of the camera. Even in the past war, the brush was used as a companion to the lens. And from this medium, generations of Americans have come to know what their men-of-war looked like, and how they operated. It has made them proudly familiar with the famous heroes of the Navy—Jones, Preble, Decatur, Farragut, Dewey and Sims—and with the unsung men of the bridge, the fo'csle and the lower decks.

The naval artist, working after the battle, has, in a limited sense, the advantage over the man with the camera. He has been able to arrange his subject to suit himself. He has had control of the whole situation, pictorially—the lighting, the action, the smoke of battle, even the cloud formations. Consequently, the brush has spoken dramatically and effectively through the years for the Navy.

But the pictorial medium, for all of that, has only come into its own with the advent of the camera—and not even then until the camera's lens has come close to being as facile as the brush.

Camera Records Actuality

For military photography has come to mean actuality—the dramatic pres-

entation of things as they were at the moment of portrayal. The impact of photography on the imagination and the interests of the American people has increased mightily in recent years. Yet no picture of today could stir the mind and the heart more than did one of the first photographs taken by the Navy—a photograph made by Mathew Brady in 1862, of the historic Federal ironclad Monitor. There, for the first time, the people saw the reality of her ironclad deck—as it appeared at the end of her battle with the Confederate's challenger, the ironclad Merimac, in Hampton Roads in March of that Civil War year.

Eighty years later, Americans were aroused to even greater efforts in behalf of their country's victory—by photographs of another great conflict. On January 31, 1942, when a U. S. Navy task force went on the offensive against the Japanese stronghold on the Gilbert and Marshall Islands, the Navy's photographers also went into the offensive. Great newspictures came out of this battle—as they did from many another conflict of the past war—pictures which were distributed within a matter of days to thousands of newspapers and magazines throughout the United States and the allied world.

Today, there is no longer any novelty about the use of the camera as a weapon of war—a weapon, not of attack, but of information and inspiration. Again and again, as the great battles of World War II were related on film, in all their heroic fearfulness, the American people responded by increased determination for victory. Recruiting in the U. S. jumped sharply time and again, as the pictorial record, made under fire, came back to the people.

Yet much of the Navy photographer's work today is for official purposes only—as a part of the interior Navy operations—as separate from its public releases.

Many Applications of Film

Today, the utilization of film records within the Navy is as varied as are the operations of the Navy. Records of damage to ships and installations are permanently charted by film. Construction progress in shipyards and naval establishments are related by the camera. Geological surveys and topographical map-making are no longer dependent on the limited diagrams made by men on foot and by guess—but are implemented by the thousands of photographs made every year by aerial photographers—and now, further by the record of the camera within the rocket. Today, the coves of seldom visited islands and the wastelands of the far north and of Antarctic ice regions are as familiar to the mapmakers as though they had been traversed, foot by foot, for the charting.

The progress of Naval medicine has been speeded up by the use of photography. Millions of feet of film have been exposed to bring to the doctors and the corpsmen, the records of new treatments, new medical advancements in fighting disease, in surgery, in rehabilitation.

Films Cut Training Time 40%

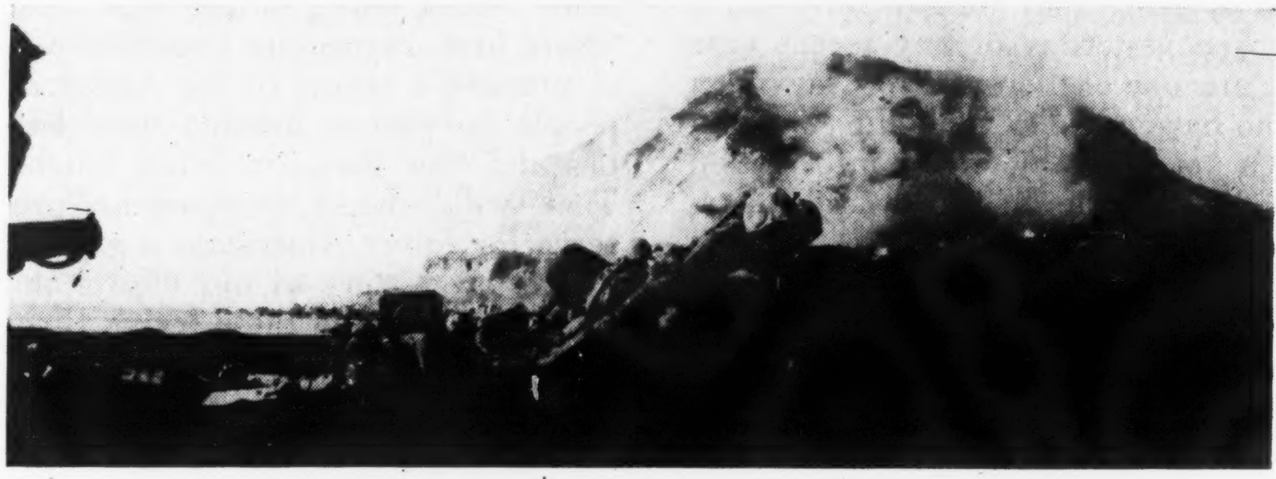
Today, the Navy uses the medium of photography to help train men in the operations of almost all Naval weapons and equipment. A sailor learns from film how to empty a jammed anti-aircraft gun, how to plot a radar-controlled plane landing, how to shore a ship's damaged bulkhead, or how to order naval supplies from the Navy's stores ashore. He learns how to tend the sick and wounded at battle station, how to flare a pipe, or how to take a depth-sounding.

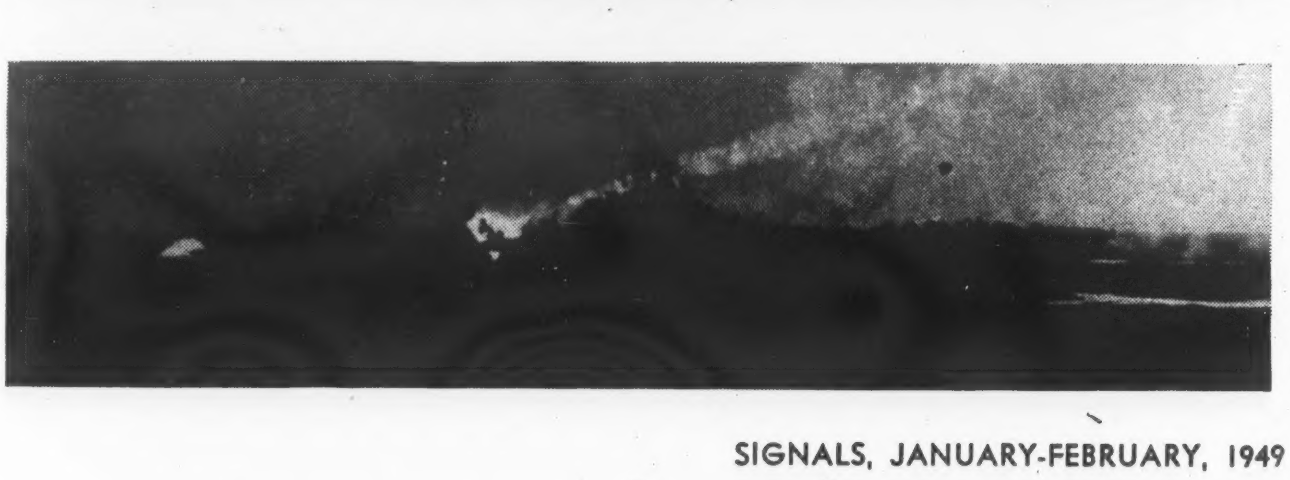
During the last war, the Navy determined that their men were trained in at least forty percent less time through the use of film, than it had taken for similar previous training without the visual aid.

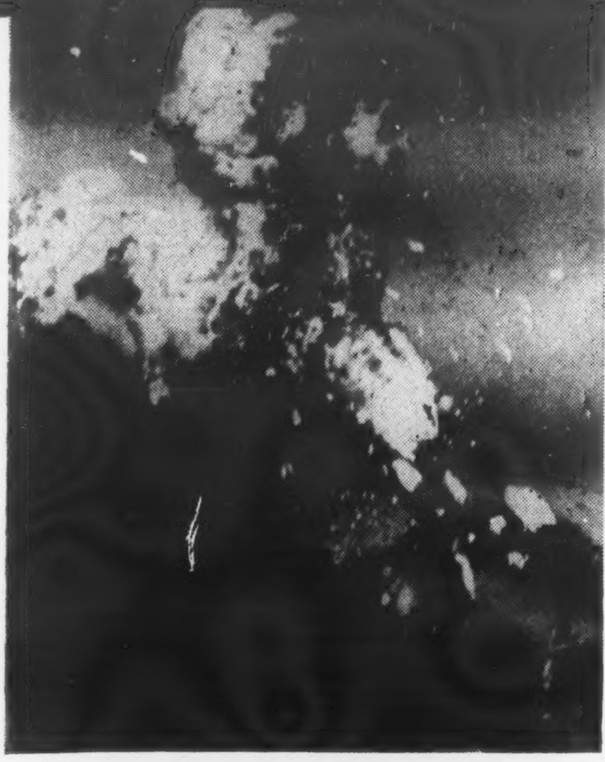
A tally of destruction in relation to Navy action against enemy targets is also a part of photography's contribution to successful operation. Photographs record the damage—and aid in the preparation of strategy for future attack, or defense.

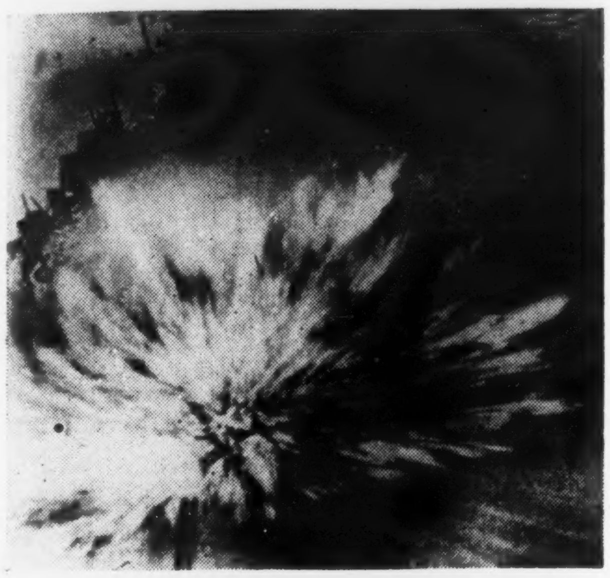
Production of war-time training films ran into the thousands. The

The artist's brush produced picturesqueness in depicting scenes of early naval battles but the artist's imagination never brought into the scenes the drama of on-the spot recordings of the Navy photographer's camera — Marines storming the beach on Iwo Jima, a carrier's last hour, a Japanese plane disintegrating just above a U. S. Naval vessel, a carrier's deck at the moment of receiving a direct bomb hit.









Navy passed its mililon-print mark at least a year before war's end. Photographic budgets were an important part of every Navy appropriation.

But the pre-war course of Navy training film development had been one of rough sailing and trimmed sails.

Navy historical files indicate that the first use of film for actual training purposes probably was about 1915. At that time it became an accepted practice to check gunnery scores through the use of photography. The first photo camera group to provide such assistance was organized in 1915. Triangulation cameras were set up on either side of a ship's fantail, with a motion picture camera in between. A large clock was placed between the camera and stern of the ship. The boat would thereupon anchor 300 feet off target and, on signal, the photographic team would turn their lenses on the fall of shot.

These same gunnery scoring films might also be said to be the first film used aboard ship for crew incentive purposes. The films were usually shown to the men in groups, and it was readily seen that the spirit of competition in performance was thereby increased.

Naval photography is far more often associated with Naval aviation, however, for from its very beginnings it was the Naval aviators who earliest saw the advantages of training by the use of film. And it was from the Bureau of Aeronautics that the most insistent and farsighted requests came for developing that field.

The real development of Navy photography began with an amateur's apt use of his camera to assist in ordering airplane parts. In 1914 W. L. Richardson, then an enlisted man, was assigned to the USS *Mississippi* which was carrying two seaplanes. Richardson had with him a small pocket camera, and he made good use of it. In those days most parts of an airplane were specially made, and written descriptions, when ordering replacement parts, often could not adequately define the renewal material. Richardson saw that photographs could complement the written order. And he made them.

In 1917, Richardson, raised to the rank of ensign, reported to Miami, Florida, to establish a Naval School of Aerial Photography. In 1918, he submitted a detailed report for the development of "educational motion pictures and still photography . . . for use in training pilots, airplane mechanics and riggers." The report went into storage along with the guns, along about Armistice Day.

In 1924 and 1925, the first formal training films were made—a series on electricity—to be used first aboard the USS *Omaha*. Results of the experiment at the time did not seem to warrant enlarging the program to cover other ships. For, according to letters on file in the Navy Department from the skipper of the *Omaha*, "few officers or men could be induced to attend the shows." The correspondence goes on to relate that, unless so ordered, the crews could be counted on to view the films only if they were interspersed with entertainment feature films such as "Tillie the Toiler" and "Somebody's Love Affair" — which were currently being shown for shipboard entertainment.

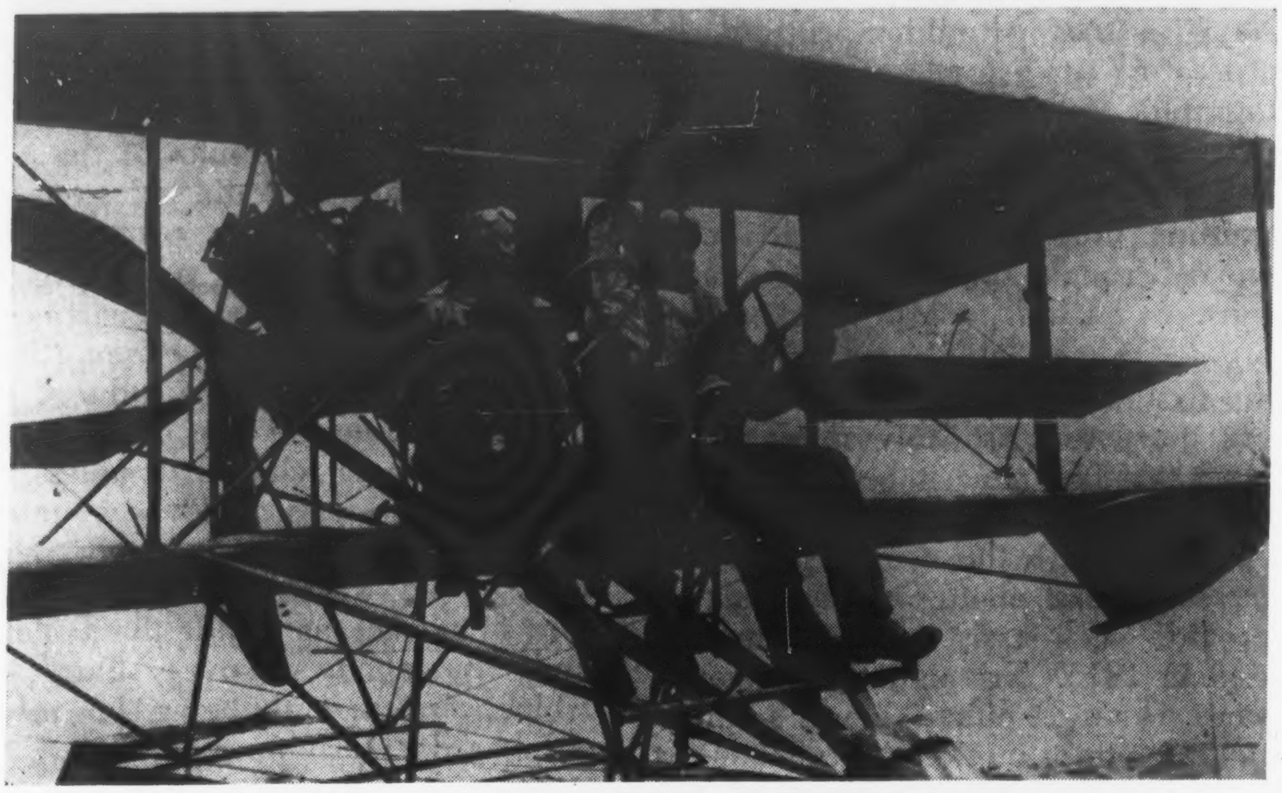
The use of slide-films, however, became a semi-acceptable medium of training along about 1927. A Navy Slide-Film School was set up in 1929 —with a personnel of *five* men.

By 1928, there was some evidence of increased interest in motion pictures for training — particularly at boot-camps. Too, films came into common use for gunnery training—since funds for actual gunnery practice were too limited to allow more than the firing of some ten rounds of ammunition in the battle practices held two or three times a year.

Early in the 'thirties, the then-Lieutenant — now Captain — Samuel Kelly, appears to have carried the ball for Navy photography in what must have seemed, for a long time, to be a losing battle of one man against the U. S. Navy. As early as 1934, he prepared a report documenting a broad training film program, to standardize training, in order to lessen the reliance upon many different teachers to do a standard training job throughout the service.

Kelly's report suggested that Naval photographic activities might well be located near film studios in the Los Angeles area. It took World War II to activate that recommendation . . . whereas the over-all report stayed buried but four years. Rewritten by Kelly in 1938, the later report included a suggestion of subjects which might well be covered by film —including "Rules of the Nautical Road." Again, this latter recommendation bore fruit only when a war emergency hit the Navy, along with the load of hundreds of thousands of dry-land sailors who had to be trained in record time.

As to the report itself—it brought forth a critical reply from the Secretary of the Navy, stating that "Motion pictures to be used for instruction purposes are not regarded with favor by Naval Operations." The re-



The late Walter L. Richardson, often referred to as the "Grandaddy of Naval Photography," shown holding a 5 x 7 Graflex camera, made the first Naval aerial photograph at Pensacola in 1914. Richardson was largely responsible for establishing the Navy School of Photography, Pensacola.

Below: Navy photographers with assorted cameras, 1920.

ply concluded that the most possible use for films in training might be in relation to reserve programs — but that even such use of film might be open to question because of security problems.

Coincidental with his second report, Kelly also wrote a magazine article in 1938—which was finally published in the 1941 "Proceedings of the Naval Institute." The article, following much the same line as the report, met with what the Navy later itself documented as a "frigid reception" from official quarters.

The first official budget request for Navy motion pictures was made in 1941—by the then Lieutenant—now Captain—Robert S. Quackenbush, Jr. —who, seven years later, was to direct all photography for the South Pole Operation "Highjump." "Quack," as his Navy friends call him, asked for $25,000 for a single film for pilots. The request was denied.

Later in the same year, the Chief of the Bureau of Aeronautics put his approval on an apporpriation request for $50,000 for films for use at Naval Air Stations.

Then, only a few months later, Kelly's dream became a reality. An eight million dollar appropriation was requested—and approved—for Naval photography.

Naval photography, for all branches, thereupon became the responsibility of the Bureau of Aeronautics. The Bureau was chosen—and forever after envied by other Naval Bureaus—because it had maintained both its interest in photography, and also a so-called *photography desk* for some twenty years.

Underway at last, the Navy's training film program, in its first real year of activity, produced 48 motion pictures and 253 slide-films.

Soon, all Naval stations and every ship of any size had their own projection equipment — their own film libraries. Some of the larger ships carried as many as five hundred revolving prints. (One of the legends of the war relates to such a library—on a big carrier. It is said that when the carrier was lost, hundreds of lives were saved by the fact that the film "Care of the Sick and Wounded at Battle Stations" had been shown, night after night, repeatedly, to the crew—so that, when the emergency hit, most of the men aboard the ship knew how to care for the men who needed emergency treatment.)

Throughout the Naval services, photographs and motion pictures made aboard ship and at naval sta-

A Navy photographer records ship's progress in Antarctic during Operation Highjump.

Navy repairman overhauls aerial camera at the Naval Photographic Center, Anacostia, D. C.

tions are the responsibility of the commanding officer. Under the provisions of General Order #96, he has the authority to release unclassified film at the time of availability.

When the commanding officer is in doubt as to the propriety or advisability of releasing photographs by naval photographers under his command, he dispatches the films to the Photographic Section, Bureau of Aeronautics, Navy Department, as quickly as possible, for clearance of classification.

On the other hand, film made by accredited civilian photographers relating to Naval matters, must immediately go to the Office of Public Relations, Navy Department, Washington, D. C. If such film arrives at the Navy Department undeveloped, it is sent to the Bureau of Aeronautics Photo-Science laboratory for processing. When returned to Public Relations, civilian film is thereafter turned over to inspection officers familiar with existing security regulations, and responsible for custody and release of the film. All film which is deemed of a non-restricted nature is, of course, immediately released for distribution to newsreels or press.

The Navy Department, acting on the theory that it is better to use more film than necessary, rather than risk missing something that might conceivably be technically informational, currently newsworthy or historically important, requires that movies and stills be made wherever there seems any indication that such might be the case. This is true even if the pictures must remain temporarily, or even, permanently restricted. This is on the principle that it is better to take a picture first and then consider whether it should be censored, than to neglect or forbid a picture which may have great value. In short: shoot first—censor later, if necessary.

In the Navy's pressroom in Washington a Public Relations officer daily explains and distributes photographs to correspondents representing the newspapers, magazines and picture agencies in the U. S. These pictures go out fully captioned, and often accompanied by factual releases which provide basis for text stories.

The Navy's organization for the production of training and combat photographs and films is a vast network of facilities and specialized personnel. It maintains its own production units, laboratories, and camera equipment. Its experimental work in the development of photographic weapons has brought about great strides in both the military and commercial photographic field.

War's Unique Problems

Confined almost exclusively, pre-World War II, to the making of documentary and public information films, Navy photography met with numerous new problems in the radically new techniques being utilized in the war. Much of this was without precedent, and Navy photographic laboratories were called on to solve the problems from scratch. An example of such work was the photographing of the electronic image.*

**Wartime Naval Photography of the Electronic Image, Francis V. Clasby and Robert A. Koch, presented at the Society of Motion Picture Engineers convention, Burbank, October 24, 1946.*

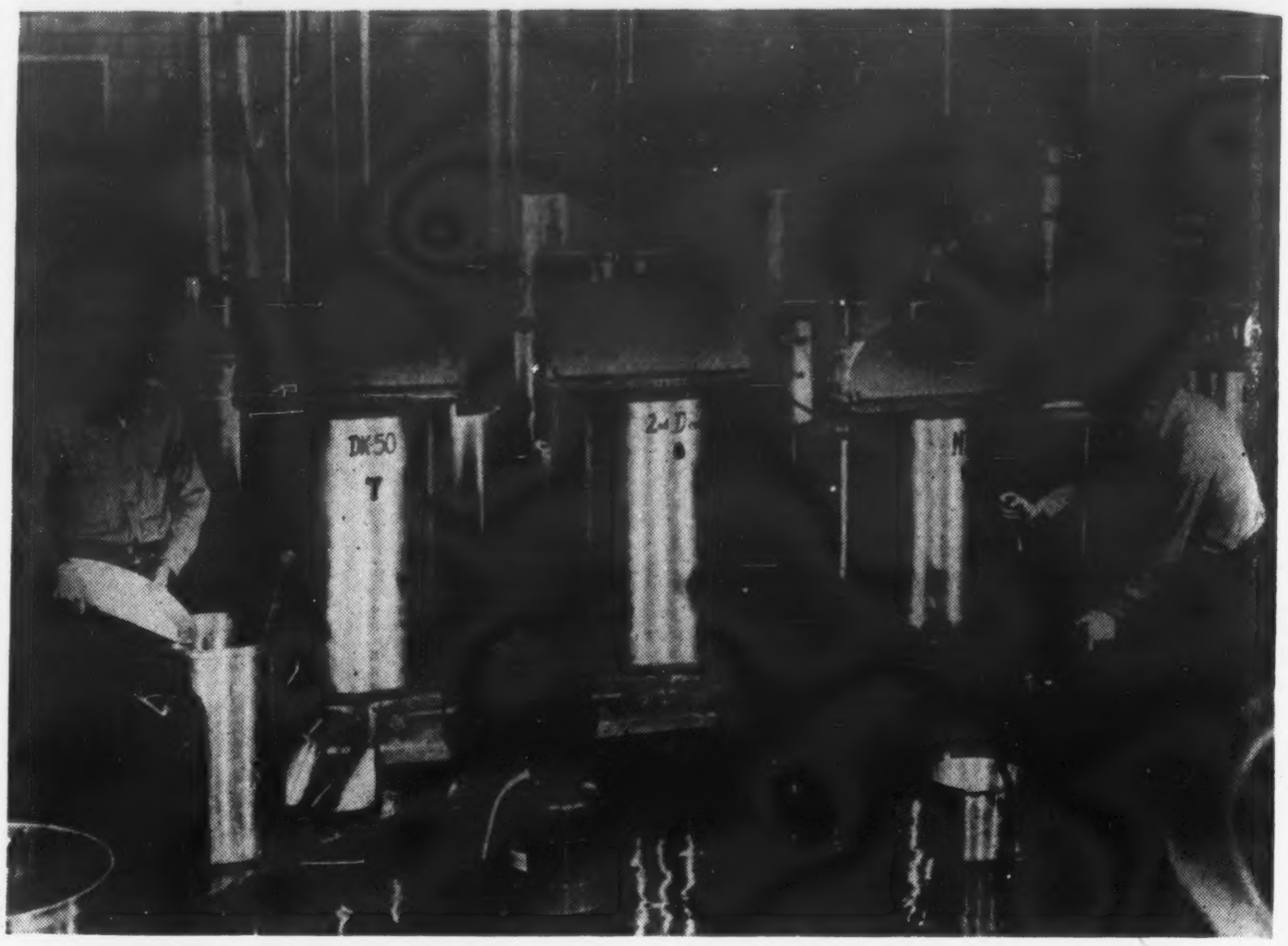
Underwater still and motion picture photography has many applications in the Navy. Below—Photographing activities at the Underwater Salvage School, Silver Springs, Florida.

With the growing use of radar, early in World War II, there arose an acute need for a training program for the increasing numbers of personnel required in the new medium. The new radar operators had to be trained quickly and experienced operators had to be taught how to utilize the newer types of radar prior to installation.

The great bottleneck in such a program lay in instructing sizable personnel to interpret successfully the wide variety of signals appearing on such equipment and to keep operators abreast of the enemy's newest method of jamming radar and confusing radar patterns. It was not always practicable or possible to demonstrate to students through actual operations the many signals and conditions which could and probably would be encountered.

No lecture, pamphlet, or book could show how to "read through" enemy jamming, yet still determine the range, bearing, and target angle of attacking aircraft. But the instruction was accomplished easily and effectively through the medium of motion pictures.

The investigation of the then virtually unexplored field of cathode-ray-tube photography was undertaken by the Naval Photographic Science Laboratory. The laboratory met and solved the many problems of light, camera speed, type of camera, type of film, and special film handling. A standard motion picture camera was rebuilt to obtain a shutter opening of 291 degrees rather than the usual 170 degree opening. Special lens coatings were developed by the optical section of the Naval Gun Factory at Washington, D. C.



Naval Photographic Center, Anacostia, D. C., Chemical Mixing Section. Formulas for from 200 to 4,000 liters can be mixed here and piped directly to the rooms in which they are used.

The research developing department of the photographic laboratory worked out a hypersensitizing aid to increase film speed.

The momentum gained during the war, both in actual physical research and development and in mental attitude toward the worth of photography as a weapon, has not been lost. The Naval Photographic Laboratory today is constantly working toward newer methods and equipment.

Problems of Extreme Cold

In Navy tests held in polar regions photography has been given full attention. The South Pole expedition Operation "Highjump" included sixty-eight photographers, not only to photograph the operation but to test equipment and material as well. In the sub-zero temperatures much malfunctioning of photographic material and equipment occurred, and out of the observations of the effects of extreme cold on the materiel many improvements will result.

It was learned on the expedition that a low temperature in itself is not responsible for camera operational failure, but rather a prolonged exposure of the camera to a low temperature. Cameras had been cold tested in laboratories, but not at long enough periods to become completely chilled. From the polar region tests, therefore, it became apparent that a special sub-zero camera would have to be produced, and the Navy laboratories are now working on such a project.

Camera malfunction in sub-zero temperatures, and a solution to that problem, was but one of several lessons learned by the photographic crew in Operation Highjump. There were problems of film, and research will be conducted to find a more suitable plastic film base for sub-zero weather. And even the tripod presented cold weather problems.

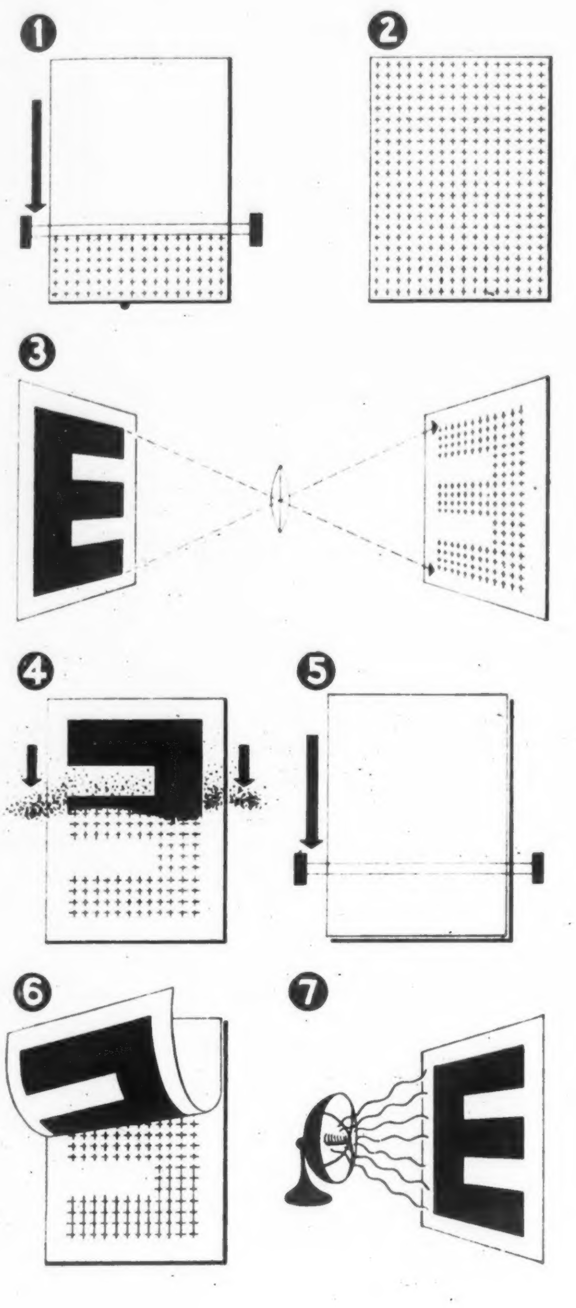
These have been but a few of the photographic problems met by the Navy, and to which the laboratories are finding the answers. There will be more problems met and dealt with. For Navy photography is now recognized as a full fledged weapon of war and an indispensable tool of research and development.

Finishing room of the still section at the Anacostia Center. Washing tanks, foreground, have a capacity of 400 prints per hour each.

XEROGRAPHY

Newest Development In Graphic Reproduction

By Joseph C. Wilson
President of the Haloid Company



1. Surface of specially coated plate is being electrically charged as it passes under wires. 2. Shows coating of plate charged with positive electricity. 3. Copy (E) is projected through lens in camera. Plus marks show projected image with positive charges. Positive charges disappear in areas exposed to light as shown by white space. 4. A negatively charged powder adheres to positively charged image. 5. After powder treatment (Fig. 4) a sheet of paper is placed over plate and receives positive charge. 6. Positively charged paper attracts powder from plate forming direct positive image. 7. Print is heated for a few seconds to fuse powder and form permanent print.

Xerography — a new dry process using electrostatic principles to reproduce charts, documents, letters, engineering drawings and other line work on virtually any surface, is the latest development in the field of graphic reproduction. It has the advantages of speed, economy, simplicity and potential adaptability to many uses. The U.S. Signal Corps is sponsoring further research on possible applications in the field of military photography.

The process was publicly demonstrated recently before the Optical Society of America in Detroit. It revealed that a picture could be taken and a print made on ordinary writing paper or other material without chemicals, fumes, negatives or sensitized paper—in less than one minute!

Xerography (pronounced "ze-rog'-ra-fee") and derived from the Greek word "xeros" meaning dry and "graphos" meaning writing, differs from present methods in that it achieves by electrostatic means what is now done by chemicals. Invented by Chester F. Carlson, a New York physicist and patent attorney, it was developed to its present status by The Battelle Memorial Institute of Columbus, Ohio, a non-profit research institution. The major sponsorship was that of The Haloid Company of Rochester, N. Y., manufacturer of photographic papers, photocopying machines and negative materials for the graphic arts.

The Principles

Xerography is based on two principles long known to scientists. One is the principle of "photoconductivity," or the ability of certain insulating materials to become electrically conductive when acted upon by light. The other is the "tribo-electric" effect or the electrical attraction which exists between two dissimilar materials in contact.

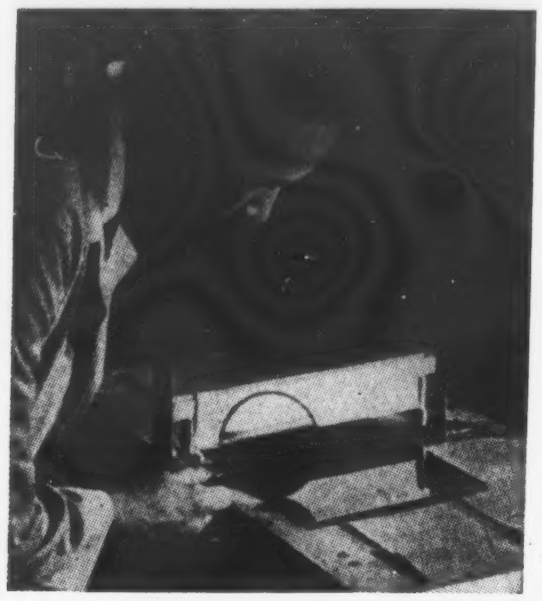
The photoconductive plate used in xerography corresponds to the film or paper used in ordinary photography. This plate consists of an electrically conductive backing material, such as metal sheet or foil, the face of which is coated with a "photoconductive insulating material." The coating is a non-conductor of electricity in the dark, but becomes conductive when exposed to light.

When the coated plate is rubbed with a cloth in the dark, or when it is "sprayed with electrons" by a simple electrical device, its surface becomes electrically charged in 8 to 10 seconds. In the charged condition the plate is sensitive to light.

The sensitized plate is exposed in a camera, through a projection lens, or in a contact printing frame in the same manner that a silver-emulsion film or silver-emulsion paper is exposed to an image pattern. Wherever light strikes the plate, the coating becomes conductive and discharges the electrostatic surface charge into the backing metal. On the places where light does not fall, the surface charge remains. Thus the image pattern causes a "latent electrical image" to remain on the plate. Dry development makes this latent image visible to the eye. The exposure is equivalent in time to that required by fast silver halide projection papers.

Developing is done by flowing specially-prepared developing powder over the plate. The powder is attracted to the charged portions of the plate and adheres to those portions tenaciously. The light-affected portions of the plate are unable to retain

A. The xerographic plate is a thin sheet of metal, coated with a "photoconductive" material. This coating will hold an electrostatic charge in the dark, but releases the charge into the backing metal whenever light strikes it. The plate may be used repeatedly in making pictures or copy reproductions.



B. To make the plate sensitive to image reception, it is passed through a "corona discharge" machine. This device "sprays" electrons on its surface. Fine wires, from which the electrons are emitted, may be seen through the enlarging glass.

C. The plate is exposed in a camera, under an enlarger, or in a contact printing frame. In this picture the technician is preparing to make a reproduction of a line drawing.

the powder and it rolls off. The result is a mirror-reversed positive image of the original subject or copy. This corresponds to the developed negative in silver-emulsion photography and takes only a few seconds.

The next step is making a permanent print from the developed image. This is done by laying a piece of paper over the powdered plate and charging the paper with the same electronic device used to sensitize the plate. The powder particles relinquish their affinity for the plate and are attracted to the charged paper. By this transfer, the image is restored to its true left-right relationship and is a direct positive reproduction of the original subject. At this stage of the process, the print corresponds to the chemically developed silver-emusion print before it is fixed in hypo. This step takes 8 to 10 seconds.

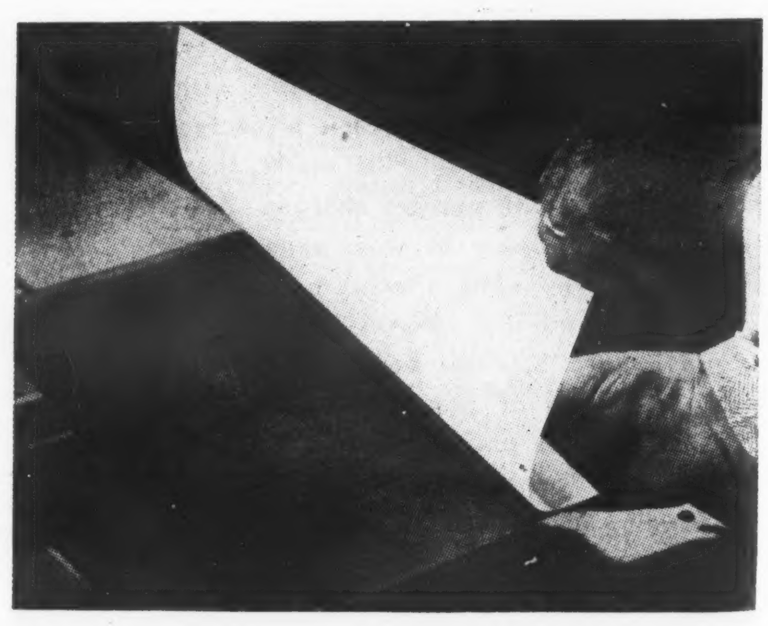
Fixing is accomplished by heating the paper print for a second or two. Heat melts the powder granules and fuses them to the paper. Heating may be done with infrared lamps, with an electrical oven, or with heated platens. The fusion temperature is no higher than that ordinarily used for drying or ferrotyping silver-emulsion prints. The prints are as permanent as the material on which the image is applied.

If the developing powder is black, and the paper upon which the print is made is white, the print will be black and white. Monotone color prints can be made directly by using developing powder that has been dyed the desired color. Multicolor prints can

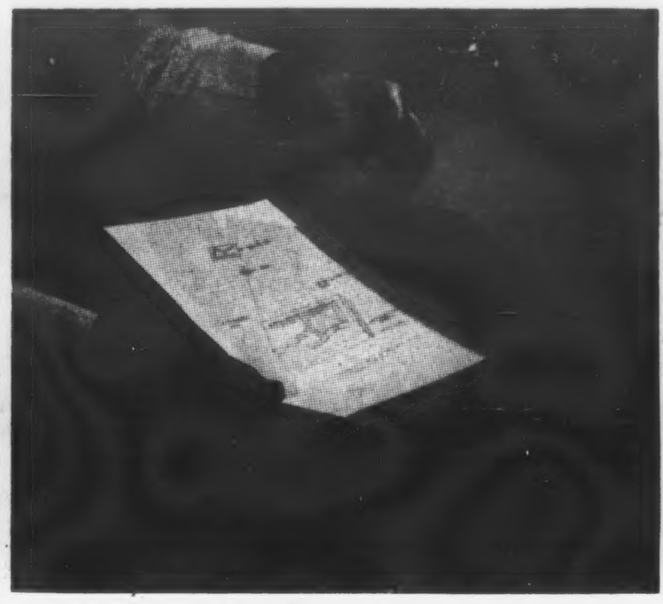
D. Following exposure, the plate is developed by flowing developing powder across its surface in a simple laboratory equipment racking tray. Oppositely charged particles of developer are released from larger carrier bodies and become attached to the image areas.

E. The developed image is positive, but mirror-reversed. It is comprised of fine particles of developing powder which are held to the plate by electrostatic attraction.

F. After development has been completed, a sheet of paper is placed over the plate, and the plate and paper are passed through the corona discharge machine again.



C. The corona discharge machine electrostatically transfers the image to the superimposed paper. After it emerges from the machine, the paper is stripped from the plate. The image has been reversed in the process making it a direct positive reproduction of the original sheet. Now the print is ready for fixing.



H. Heating the print between platens fuses the developer to the paper and makes the print as permanent as the material on which it is made.

I. Dry printing is one of the potential uses of xerography. With this experimental machine, a press speed of 1200 web-feet per minute has already been achieved. Chief advantages of xeroprinting will be the light weight of printing machinery and simplicity of plate-making. Since the image is transferred from plate to paper electrostatically, no pressures are required. The use of "dry powder" also eliminates drying and offset problems.

be made by combination prints, using separate plate images for each color.

Xerography has these advantages:

1. *Process is Dry.* Powder is used. There are no chemical solutions or fumes. For that reason, the xerographic process is easily incorporated into simple equipment.
2. *Low Cost.* Because xerography utilizes comparatively inexpensive materials in its processes, reproductions are made at a fraction of the cost of other methods. Xeroplates may be used over and over again for other subjects because the remnant of powder image remaining after transfer is easily removed.
3. *Speed.* A subject may be photographed on a xerographic plate, the plate developed and a direct positive print made and fixed in less than a minute.
4. *Exposure Speed.* Equals fast silver halide projection papers at present and it is the only process other than photography to have achieved this goal.
5. *Sensitized Paper Unnecessary.* Prints may be made on ordinary papers, cloth, glass, metal, wood, ceramics, etc.
6. *Simple Manipulation.* Xerography is simple. An unskilled person can make good xerographic prints easily, by following an established routine.
7. *Color Prints Are Possible.* By using colored developing powders, prints in any color may be made directly without intermediate steps or solutions.

Present and future applications of xerography cover an extremely broad range. Its big potential use is for copying letters and other typewritten and handwritten material, documents, plans, charts, engineering drawings, etc., on ordinary plain paper.

Copying Machine

The Haloid Company is readying for the market a compact, xerocopying machine for commercial use. Xerography can be used to make master plates for the graphic arts to print and duplicate, with powder instead of ink, to transfer designs, lettering, printing, trademarks, etc., to ceramics, porcelain, glassware, metal and wood, to print on cloth and fabrics, to record dial readings, scale weights, electrical meters, X-rays, spectographs and other scientific data and to make templates. Investigation is also being made on its application in the field of semi-micro photography.

Continuous tone xerography is now in the process of further development. Major General S. B. Akin, Chief Signal Officer, recently announced that the Signal Corps, through its Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey, is sponsoring further research in the field of xerography, with respect to possible application in the field of military photography.

Xeroprinting

Xeroprinting is a variation of the xerographic process. A plate is made which consists of an image of electrically insulating material on an electrically conductive backing, such as a metal sheet. The plate is fastened to the cylinder of the printing machine and is ready for operation.

When the machine is operating, the image plate passes under a corona discharge device, where an electrostatic charge is imparted evenly to the plate. The charge immediately passes off the conductive or non-printing surfaces, but remains on the insulating or printing surfaces.

As the cylinder turns, the plate enters a developing chamber, in which a powder is cascaded against it. The powder adheres to the parts of the plate which retain the electrostatic charge.

At the next position of the cylinder the developed plate passes under paper which is fed into the machine by standard paper-feed contrivances. Paper and plate pass under corona discharge points, where the image is simultaneously transferred to paper and the plate recharged for the next revolution. The paper bearing its powder image then passes over a rotary heating platen, where the powder image is fixed by heat, or under a spray, where the image is fixed by a solvent.

ASSOCIATION AFFAIRS

ARMED FORCES COMMUNICATIONS ASSOCIATION

1624 Eye Street, Washington 6, D. C.

OFFICERS AND DIRECTORS

President: David Sarnoff*
1st Vice-Pres.: Wm. J. Halligan*
2nd Vice-Pres.: Darryl F. Zanuck*

3rd Vice-Pres.: A. W. Marriner
4th Vice-Pres.: Jennings B. Dow
5th Vice-Pres.: E. K. Jett

Brig. Gen. S. H. Sherrill, U.S.A. (Ret.)*
Exec. Sec. and Treasurer:
Counsel: F. W. Wozencraft*

DIRECTORS AT LARGE

Paul Galvin (1949)
H. A. Ehle (1949)
Dr. J. A. Stratton (1949)
J. Harry LaBrum (1949)
John J. Ott (1949)
Dr. Harold A. Zahl (1949)

Carroll O. Bickelhaupt (1950)
Theodore Gary (1950)*
Thomas H. A. Lewis (1950)
Thomas A. Riviere (1950)
Dr. Lee De Forest (1950)

William C. Henry (1951)
Dr. Frank B. Jewett (1951)
Fred R. Lack (1951)
Leslie F. Muter (1951)
Charles E. Saltzman (1951)
S. H. Sherrill (1952)

*Executive Committee Member

AFCA National Election

As provided by our Constitution, nominations for president and vice presidents (not to exceed five), and five directors are to be submitted by the Council to National Headquarters by February 1st. The nominees will be voted upon at a Council meeting in Washington during the annual convention in the Spring. The officers elected at that time will replace the present incumbents on July 1st and are expected to include top level officials from communications companies not previously represented. The new president, probably, will be some one from industry identified with communications for the Navy. Chapter presidents were advised early in December to invite their members to select representatives on the National Council. It is expected that members will submit their nominations to their chapters.

Executive Committee Meeting

The regular quarterly meeting was held at national headquarters in Washington on December 14. Discussion was had on a slate of new officers and directors to be considered by the nominating council on February 1.

Tentative plans for the Industry-Army Day meeting in Boston on February 4 were discussed. Speaker at the banquet will be General Omar Bradley, and speakers at the Signal Corps meeting at noon will be four especially selected staff officers of the Chief Signal Officer, and an off-the-record Army Department policy presentation will be made in the afternoon by Colonel J. Lawton Collins of the office of the Chief of Staff.

The Executive Committee voted to:

a. Select not to exceed five Association members each year who had made outstanding contributions to the Association or to national defense, and give them a special award.

b. Designate Theodore S. Gary of Chicago as director in charge of chapters, in an effort to increase chapter activities with the resulting increases in membership in certain areas.

The Executive Secretary discussed the financial condition of the Association which showed considerable improvement during last year. He outlined the purposes of the special committee appointed to consider ways and means of increasing the Association's effectiveness and its membership. The Committee, which consists of top communications chiefs of the Armed Forces and representatives of industry, met December 14 in the Pentagon.

Industry-Army Day

General Omar Bradley and General J. Lawton Collins, Vice Chief of Staff, will be the principal speakers at the Industry-Army Day meeting which will be held at the Hotel Statler in Boston on February 4th. At least fifteen hundred top industrialists from all over the United States will be on hand. A complete report of the meeting will appear in March SIGNALS.

Joseph L. Egan

In the death on December 6th of Joseph L. Egan, President of the Western Union Telegraph Co., our Association has lost one of its charter members and one who supported the patriotic aims of AFCA since it was founded. We extend our sympathies to his family and to his associates of the Western Union Telegraph Co., a charter group member of AFCA.

Gary Committee Meets

A special committee met in the Pentagon on December 14th to discuss ways and means of making AFCA more useful to the services. Theodore S. Gary, a director of AFCA and Vice-President of the Automatic Electric Company, served as the committee chairman. The other members were: the chiefs of the com-

National Advisory Committee Chairmen

GENERAL MANUFACTURING: **Mr. Fred R. Lack, V. Pres., Radio Division, Western Electric Company, New York City**

BATTERY MANUFACTURING: **Dr. George W. Vinal, Bureau of Standards, Washington, D. C.**

DRY BATTERY SUBCOM.: **Mr. Ralph E. Ramsay, V. Pres. & Research Director, Ray-O-Vac Company, Madison, Wisconsin**

STORAGE BATTERY SUBCOM.: **Mr. L. E. Wells, Chief Engineer, Willard Storage Battery Company, Cleveland 1, Ohio**

RADIO MANUFACTURING: **Mr. Fred R. Lack, V. Pres., Radio Division, Western Electric Company, New York City**

TELEGRAPH EQPT. MFG.: **Colonel Julian Z. Millar, The Western Union Telegraph Company, New York City**

TELEPHONE EQPT. MFG.: **Mr. C. D. Manning, V. Pres., Kellogg Switchboard & Supply Company, Chicago, Illinois**

COMPONENTS MFG.: **Mr. R. C. Ellis, V. Pres., Raytheon Manufacturing Company, Waltham, Massachusetts**

PHOTOGRAPHIC EQPT. MFG.: **Mr. H. A. Schumacher, V. Pres., Graflex, Inc., Rochester, N. Y.**

RADAR: **Mr. George F. Metcalf, Manager, Electronics Laboratory, General Electric Company, Syracuse, N. Y.**

WIRE MANUFACTURING: **Mr. H. Donn Keresey, Pres., Anaconda Wire & Cable Co., New York City**

PUBLICITY: **Mr. Orrin Dunlap, Jr., RCA, 30 Rockefeller Plaza, New York 20, N. Y.**

MILITARY TRAINING: **Major Gen. G. L. Van Deusen, Pres., RCA Institutes, Inc., 340 West 4th St., New York 13, N. Y.**

Atlanta Chapter Meeting. L to R: Daniel McKeever, chapter president; Capt. W. A. Brooks, Senior Naval Officer, Atlanta Area; Hal. S. Dumas, Sr., president, Southern Bell Tel & Tel Co.; Maj. Gen. Leland S. Hobbs, Deputy Commanding General, Third Army; Rear Adm. Earl E. Stone, Naval Chief of Communications; Lt. Col. George H. Kneen, CO, Marietta Air Force Base.

munications services of the Army, Navy and Air Force—General Akin, Admiral Stone and General Ankenbrandt; representing industry—Fred R. Lack, Western Electric Co.; A. W. Marriner, IT&T; W. W. Watts, RCA Victor; and, as additional members: Col. F. W. Wozencraft, AFCA's legal counsel, and Brig. Gen. T. C. Rives of the Air Materiel Command.

The Executive Secretary, General S. H. Sherrill, presented a report on the status of the Association and its organization to render service from industry to the communications activities of the Army, Navy and Air Force, comparable to that given to the other supply services by the American Ordnance, Navy Industrial Association and similar associations. Individual membership is expected to double through local chapter efforts to interest all members of the communications industry. As a step to accomplish this, it is anticipated that the number of chapters will be increased to thirty-five.

Committee on Amateur Radio

At AFCA's annual meeting in Dayton, Ohio, in May 1948, a special committee was appointed to study possible uses of amateur radio operators of the country to meet a national emergency. George R. Call of Sioux City, Iowa, was designated chairman, with Mr. George S. Bailey, president of ARRL, Captain E. L. Nielsen (Army), Major R. H. Ralls (Air Force), and Major C. F. Welsh (Marines, for the Navy) as the other members.

An exhaustive study of the situation and the possible uses of radios in taxicabs and amateurs organized by the three services and by the ARRL was made and a detailed plan prepared. At the final meeting of the committee, at which Mr. Call presided, it was decided that:

1. The so-called MARS (Military Amateur Radio Service) committee, recently organized should first be expanded by the inclusion of Navy representatives.

2. The committee as then organized should draw up an overall plan.

3. This plan would include representation from ARRL, FCC and OCD.

4. Initial problems of the resulting committee would include:

   a. To prepare necessary detailed plans for integration of the military and civilian aspects of amateur radio networks.

WHEN DOES YOUR MEMBERSHIP EXPIRE?

LOOK AT THE EXPIRATION DATE ON YOUR MEMBERSHIP CARD. IF IT IS WITHIN 30 DAYS, IT'S TIME TO PAY YOUR DUES.

Mr. T. S. Gary, AFCA vice president in charge of chapters, discussed the formation of an Hawaii chapter during his visit to the Islands in December. L to R: Lt. Col. Edwin A. Redding, Commander, Sig Serv Gp, USARPAC; Lt. Col. Harold McD. Brown, Plans & Policy, Sig Serv, USARPAC; Mr. Gary; Col. Carl H. Hatch, Sig Off, USARPAC; Mr. J. R. Reed, Genl. Mgr., Automatic Electric Sales Corp. of Honolulu.

b. To prepare plans and initiate the necessary action to provide for civilian amateur radio operation in periods of national emergency.

c. To coordinate the MARS program with the United States Navy.

Also present at the meeting were:

Lt. Col. Fletcher—Signal Plans & Operations Division

Col. Sheets—USAF, Office of Director of Communications

Major Rantz — USAF, Air Defense Command

Lt. Col. Eddy — Army Communications Service Division.

Technical Schools Study

Mr. E. H. Rietzke, of the Capitol Radio Engineering Institute and a life member of AFCA, is serving as chairman of a special committee on technical schools. The committee is studying the use of these schools during World War II with a view to recommending for consideration by the Army, Navy and Air Force improvements in the procedure followed at that time, should the services again decide to supplement their own schools by the use of selected private technical schools. The study will include a survey of existing facilities that can be quickly adapted to a military training program.

Chapter Constitutions

Printed copies of AFCA's Constitution and By-Laws have been sent to all chapters. It is expected that chapters will now submit their constitutions to National Headquarters for approval. Only three chapters have so far done so. Copies of the National Constitution are available to any member on request.

AFCA Awards

The following special annual awards will be made by the Association this year:

1. *Outstanding Student Award*—consisting of a medal and scroll given to the outstanding Senior ROTC student (Army, Navy or Air Force) majoring in communications. This award will be presented at each of the following colleges:

   Virginia Polytechnic Institute
   Clemson Agricultural College
   University of Maine
   Massachusetts Institute of Technology
   University of Alabama
   Oklahoma A&M College
   Texas Technological College
   University of California
   Cornell University
   New York University
   State College of Washington
   Iowa State College
   Georgia Institute of Technology
   Rutgers University
   Michigan State College
   A&M College of Texas
   Kansas State College

2. *Annapolis and West Point Awards*—given to the midshipman and cadet excelling in the study of electricity or electronics. The awards will be Eastman-Kodak cameras.

3. *Essay Contest.* An award, consisting of a set of books to be chosen by the winner, is being offered to the Senior ROTC student (Army, Navy or Air Force) who submits the best essay on "Communications and National Security." All units have been informed of this contest, which ends on March 15, 1949. To be eligible, units must apply to AFCA National Headquarters.

4. *Chapter of the Year Award.* A scroll is presented to the AFCA chapter that shows the most improvement as an active chapter during the year ending May 1, 1949.

5. *Unit Contest.* A competition between communications and photographic units of the Air Force, Navy and Regular Army, National Guard, and Reserves for increased membership was launched July 15, 1948, and will continue until March 1, 1949. There will be two winners — one for the greatest number of new members or renewals, and the other for the highest per cent of the total strength who become members. A special scroll will be presented to the winning units.

New Certificates

New certificates to replace the old ASA certificates are being sent to all life members. Also new AFCA charter certificates will be mailed to all chapters.

Legal Aid for Servicemen

State Bar Association Committees for legal service to the Armed Forces have been set up in every state. A letter received at AFCA headquarters from the Washington, D. C., Bar Association Committee on Legal Assistance to Servicemen states that "the basic purpose of setting up such committees was to see that all requests for legal service by servicemen were placed in the hands of reliable, competent and sympathetic counsel who will give due consideration to the serviceman's ability to pay fees, but in any event, to see that needed services are rendered." Any veterans desiring information concerning legal assistance should write to the State Bar Association Hqs. at their state capital.

12th Army Group News

"Cross Talk"—a copy of B. I. Noble's mimeograph with bits of news of old 12th Army Group personnel—is available on request to National Headquarters.

Chapter of the Year

The following chapters were running in the lead as of December 31st:

Kentucky
Atlanta
Sacramento
New York
Richmond

The next four months will determine the winner. Consult September 1948 SIGNALS for the rules governing the contest.

HOOK COMMITTEE REPORT

Few persons realize that one class of public servants has had practically no pay increase since 1908—the commissioned officers in the higher grades in the armed services. AFCA has emphasized repeatedly since September, 1946, the importance of action to correct this condition as a requirement for better national defense. In the months since that time we have seen more and more of the best men in the services, including many in communications and photography, resign or retire to accept positions in civilian life in which their ability is recognized and rewarded.

It is not to be expected that service salaries would reach the same figures as they do in the commercial world, since the spirit of service must always be of paramount importance in the creed of the professional officer. But a need for a general pay study and revision has existed for a long period of time. An increase of about 66 percent in salaries is being recommended for cabinet officers. Congress over two years ago raised its own salaries by some 50 percent.

The Secretary of Defense' special board of civilians, under the chairmanship of Mr. Charles R. Hook, has now completed its long and extensive study of service pay as compared with pay for comparable civilian positions. It submitted in December its comprehensive and intelligent recommendations. These merit prompt and favorable action by the Congress if the services, both regular and reserve, are to continue to attract a fair share of young American men of merit—and we must have them to keep abreast of tactics, technique and strategy of war so that we may be strong and thus discourage attack or win speedily any war that is forced upon us, with the most advanced equipment and methods and with the least loss of American life and property. The recommendations will ensure democratic armed forces in a democratic country where success has certain rewards which all have an equal opportunity to seek and win.

Industrial Minute Men of 1949: Communications & Photography

Listed below are the names of the American firms who are group members of the Armed Forces Communications Association. By their membership they indicate their readiness for their share in industry's part in national security. These firms and their employees are a part of that patriotic group which Secretary Forrestal said is needed so that the armed forces can learn of the most advanced industrial and commercial techniques, and to which they may turn for advice on research, manufacturing, procurement and operation.

Acme Newspictures, Inc.
Admiral Corporation
American Phenolic Corporation
American Steel & Wire Company
American Telephone & Telegraph Co.
American Time Products, Inc.
Anaconda Wire & Cable Company
Arnold Engineering Company
Astatic Corporation
Automatic Electric Company
Automatic Electric Sales Corp.
Baltimore News Post
Baltimore Radio Show, Inc.
Bell Telephone Company of Pa.
Bendix Radio
Bliley Electric Company
Breeze Corporations, Inc.
California Water & Telephone Co.
Capitol Radio Engineering Inst., Inc.
Carolina Telephone & Telegraph Co.
Chesapeake & Potomac Tel. Co.
Chicago Telephone Supply Co.
Cincinnati & Suburban Bell Tel. Co.
Cinch Manufacturing Corp.
Collins Radio Company
Colonial Radio Corp.
Commercial Radio-Sound Corp.
Copperweld Steel Company
Cornell-Dubilier Electric Corp.
Corning Glass Works
Coyne Electrical School, Inc.
DeJur-Amsco Corporation
Diamond State Telephone Co.
Drake Manufacturing Co.
Allen B. DuMont Laboratories, Inc.
Eastman Kodak Company
Hugh H. Eby, Inc.
Thomas A. Edison, Inc.
Electric Storage Battery Co.
Electronic Associates, Inc.
Electronic Designs, Inc.
Emerson Radio & Phonograph Corp.
Espey Manufacturing Co., Inc.
Federal Telephone & Radio Corp.
Freed Radio Corporation
General Aniline & Film Corp.
General Cable Corporation
General Electric Company
General Instrument Corp.
General Precision Equip. Corp. & Subs.
General Telephone Corp.
Gilfillan Bros, Inc.
Globe Wireless, Ltd.
Graflex, Inc.
Gray Manufacturing Co.
Hallicrafters Company
Haloid Company
Hazeltine Electronics Corp.
Heinemann Electric Company
Hercules Motors Corp.
Hewlett-Packard Company
Hoffman Radio Corp.
Ilex Optical Co.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
International Detrola Corp.
International Resistance Co.
International Tel. & Tel. Corp.
Jacobsen Manufacturing Co.
Kellogg Switchboard & Supply Co.
Lasting Products Co.
Leich Sales Corporation
Lincoln Telephone & Telegraph Co.
Link Radio Corporation
Machlett Laboratories, Inc.
Magnavox Company
P. R. Mallory & Co., Inc.
Massachusetts Radio & Telegraph School
Merit Coil and Transformer Corp.
Michigan Bell Telephone Company
Mines Equipment Company
Mountain States Tel. & Tel. Co.
Mutual Telephone Company
National Carbon Company, Inc.
National Fabricated Products, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Company
New York Telephone Company
North American Philips Co., Inc.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Company
Okonite Company
Olin Industries, Inc.
Operadio Manufacturing Company
Pacific Telephone & Telegraph Co.
Philco Corporation
Radiart Corporation
Radio Condenser Company
Radio Corporation of America
RCA Victor Division
Rauland Corporation
Ray-O-Vac Company
Reeves Instrument Corp.
Servo Corporation of America
Sherron Electronics Co.
Sonotone Corporation
Southern Bell Tel. & Tel. Co.
Southern New England Tel. Co.
Southwestern Bell Telephone Co.
Sparks-Withington Company
Sperry Gyroscope Company
Stackpole Carbon Company
Standard Piezo Company
Stewart-Warner Corporation
Stromberg-Carlson Co.
Stupakoff Ceramic & Mfg. Co.
Sylvania Electric Products, Inc.
Telephone Services, Inc.
Teletype Corporation
Time Facsimile Corporation
Tri-State College
Tung-Sol Lamp Works, Inc.
Tyler Commercial College
United Radio Television Institute
United States Electric Mfg. Corp.
United States Rubber Company
Wm. H. Welsh Co., Inc.
West Coast Telephone Company
Western Electric Company, Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Willard Storage Battery Co.
Wisconsin Telephone Company
Wollensak Optical Company

Chapter News

☆ ☆ ☆ ☆ ☆ **Chapter Of The Year, 1948 — Far East, George I. Back, President** ☆ ☆ ☆ ☆ ☆

National Director of Chapters: **Theodore S. Gary, 1033 W. Van Buren St., Chicago, Ill.**

AREA REPRESENTATIVES FOR CHAPTERS

Area A: **George P. Dixon, IT&T Corp., 67 Broad St., New York, N. Y. New England States, New York, New Jersey and Delaware**

Area B: **J. H. LaBrum, Packard Building, Philadelphia, Pa. Indiana, Kentucky, Maryland, Ohio, Pennsylvania, West Virginia and Virginia**

Area C: **W. H. Mansfield, Southeastern States along Atlantic and Gulf coasts—from North Carolina to Mississippi and including Tennessee**

Individuals interested in chapter activities should communicate either directly with National Headquarters or with the proper area representative.

CHAPTERS AND SECRETARIES

ATLANTA: **Maj. Peter J. Ryan, Hqs. 3rd Army, Ft. McPherson, Ga.**

BALTIMORE: **E. D. Bond, Baltimore Signal Depot, Middle River, Md.**

BOSTON: **Lt. Col. Edmund T. Bullock, Boston Army Base, Boston 10, Mass.**

CHICAGO: **Col. Raymond K. Fried, 111 W. Monroe St., Chicago 3, Ill.**

CLEVELAND: **H. E. Schafer, Radiart Corp., 3751 W. 62nd St., Cleveland 2, Ohio.**

DALLAS: **E. H. Mittanck, Rm. 816, Telephone Bldg., Dallas, Tex.**

DAYTON: **Gertrude A. Knight, 54 Patterson Village Dr., Dayton, Ohio.**

DECATUR: **Doris E. Short, 140 No. Hilton St., Decatur, Ill.**

EUROPEAN: **William M. Hart, ICD, OMGH, c/o Radio Frankfurt, APO 757, New York, N. Y.**

FAR EAST: **Maj. C. B. Whittenberg, Sig. Sec., GHQ., FEC, APO 500, c/o PM, San Francisco, Calif.**

FORT MONMOUTH: **Col. William L. Seibert, Squier Signal Laboratory, Fort Monmouth, N. J.**

KENTUCKY: **Clyde T. Burke, Lexington Signal Depot, Lexington, Ky.**

LOUISIANA: **A. Bruce Hay, Southern Bell Tel. & Tel. Co., New Orleans, La.**

NEW YORK: **Col. William H. Harrington. 195 Broadway, New York 7, N. Y.**

OGDEN-SALT LAKE: **Miss Marjorie Hansen, 2227 Adams Ave, Ogden, Utah.**

PHILADELPHIA: **Joseph Bergman, Sig. Corps Stock Control Agency, 2800 So. 20th St., Philadelphia, Pa.**

PITTSBURGH: **K. A. Taylor, Bell Telephone Co., 416 7th Ave., Pittsburgh, Pa.**

RICHMOND: **Lelia V. Fussell, Ches. & Potomac Tel. Co., 703 E. Grace St., Richmond, Va.**

RIO: **Maj. Huston Maxwell, JBUSMC, APO 676, % Pm, Miami, Fla.**

SACRAMENTO: **Maj. James A. Board, Sacramento Signal Depot, Sacramento, Calif.**

SAN FRANCISCO: **Capt. John H. Meyer, 1930 Prince St., Berkeley, Calif.**

ST. LOUIS: **Capt. Henry C. Hughes, 319 No. 4th St., St. Louis 2, Mo.**

SEATTLE: **Capt. Lawrence W. Bucy, Alaska Communication System, Seattle 4, Wash.**

SOUTHERN CALIFORNIA: **K. E. Lambert, MGM, Hollywood, Calif.**

SPANISH WAR VETERANS DIVISION: **George A. Marshall, Adj., 215 Montague St., Brooklyn, N. Y.**

WASHINGTON: **Col. Edward C. Cover, Chesapeake & Potomac Tel. Co., 725 - 13th Street, N. W., Washington, D. C.**

STUDENT CHAPTERS

CORNELL: **John M. Ross, 126 McFaddin Hall, Ithaca, N. Y.**

NEW YORK UNIVERSITY: **Robert D. Hawkins, 25 Spruce Ave., Ridgefield Park, N. J.**

OKLAHOMA A & M: **W. D. Manahan, Okla. A & M College, Stillwater, Okla.**

STATE COLLEGE OF WASHINGTON: **Stuart W. McElhenny, 604 California St., Pullman, Wash.**

TEXAS TECH: **T. L. Timmons, 2012 8th St., Lubbock, Texas.**

UNIVERSITY OF CALIFORNIA: **R. G. Barhite, Bowles Hall, U. of Calif., Berkeley, Calif.**

NATIONAL HEADQUARTERS CHAPTERS SECRETARY: JULIA B. GODFREY

Atlanta—D. A. McKeever, Pres.

Some 150 members and guests attended the December 1st meeting at the Officers' Club, Fort McPherson. Among those present were: Maj. Gen. Leland S. Hobbs, Deputy Commanding General, Third Army; Capt. W. A. Brooks, Senior Naval Officer Present Atlanta Area; Lt. Col. George H. Kneen, Commanding Officer, Marietta Air Force Base; and Mr. Hal S. Dumas, Sr., President, Southern Bell Telephone & Telegraph Co. President McKeever acted as toastmaster.

Rear Admiral Earl E. Stone, Chief of Naval Communications, delivered the principal address. He emphasized that "communications and electronics will continue to gain in importance as the tempo of modern warfare increases" and "our national security seems to be daily becoming more and more dependent upon communications and electronics." He listed the primary objectives of the Naval Communications service as: (1) means of communications for the exercising of command and administration; (2) a communications system suitable for rapid expansion to meet war requirements with a peacetime network necessarily "the nucleus of a wartime network due to limitations of funds and personnel"; (3) to maintain and operate communications facilities as required by the current Navy operating plan and the need for direct communication with our overseas possessions and bases; (4) to use Naval Communications facilities for the protection of safety of life and property at sea; and (5) to cooperate fully in carefully considered coordination and integration with the Army, Air Force and commercial communications agencies to achieve better service, greater economy and better preparedness. It is of vital interest to the Navy, he said, that the available global commercial facilities and services for communications are so established and operated as to form an efficient instrument to complement and support the Army, Navy and Air

Honor Units
Member Contest 1948

72nd Signal Service Battalion
304th Signal Operation Battalion

Force communications systems in time of national emergency. Admiral Stone then described in considerable detail the major features of Naval Communications operations.

Baltimore—F. E. Moran, Pres.

The Bendix Radio Corporation was host to the Baltimore Chapter at its meeting on November 17th. Members attended a steak dinner and heard a speech by Mr. John W. Hammond, Manager of Communication Radio Sales. This was followed by a tour of the various manufacturing activities of the Bendix plant, which included production of television and broadcast receivers, precision manufacturing and processes involved in the manufacture of aviation radio equipment and mobile communication units.

Chicago—Oliver Read, Pres.

In February officials of the Chicago Chapter will meet to work out plans for its reorganization under the leadership of Mr. Read, the secretary, Col. R. K. Fried, and the newly designated national director for chapters, T. S. Gary of the Automatic Electric Co. The National Executive Secretary, Gen. S. H. Sherrill will attend the meeting. Details were discussed at a conference between General Sherrill and Mr. Read in Washington January 8.

Cleveland—L. J. Shaffer, Pres.

The Cleveland Chapter held a business meeting on November 11th. Mr. Lee J. Shaffer was selected to represent the chapter on the National Council.

Far East—G. I. Back, Pres.

The Far East Chapter has submitted its Constitution and By-Laws to National Headquarters for approval. The By-Laws contemplate an annual meeting in the spring of the year similar to the one held within the continental United States by the national Association.

Fort Monmouth—W. A. Beasley, Pres.

A joint meeting of the Fort Monmouth Chapter and the Monmouth County Subsection of IRE was held on November 18th. An audience of 300 heard Dr. J. W. McCrae, Director of Electronic and Television Research for Bell Laboratories, deliver a lecture on "Transistors." Brig. Gen. Francis H. Lanahan, Commanding General, Fort Monmouth, introduced Dr. McCrae. The meeting was presided over by President Beasley of the Fort Monmouth Chapter and Mr. Loyd E. Hunt, Chairman of the Monmouth County Subsection, IRE.

Kentucky Chapter, AFCA, at Fort Knox meeting in November.

Kentucky—Wm. M. Mack, Pres.

On November 19th, some fifty members and guests of the Kentucky Chapter met at Fort Knox as guests of Col. C. A. Carlsten, Director of the Communications Dept. of the Armored School. After luncheon at the Club Cafeteria, the members were taken on a bus tour of the Post. They were conducted through the Armored Field Forces Board #2 by Maj. S. A. Miller, the Signal member of the Board, and at the Academic group were welcomed by Brig. Gen. Bruce C. Clarke, Assistant Commandant of the Armored School. After inspecting the Weapons Department, Command and Staff Dept. and Automotive Dept., the group returned to the Club Cafeteria for dinner. A business meeting was held in Rowe Hall, with opening comments by Col. Carlsten. Mr. John A. Short was elected chapter representative on the National Council, and Col. Carlsten was appointed to the Membership Committee for the Louisville area. At the close of the meeting, the chapter toured the Communications Department and the Patton Museum. Then, at the Officers' Club, Col. Carlsten presented each member with a diploma from the Armored School.

The December meeting was held on the 17th at the Jefferson Davis Inn, Lexington. After dinner, the gathering heard Professor Louis A. Pardue, of the Physics Dept. of the University of Kentucky, discuss "Atomic Energy" in a very interesting and easy to understand manner. The program was concluded with color movies of the Kentucky-Tennessee football game of November 20th.

Louisiana—H. B. Lackey, Pres.

The interim officers attended a luncheon meeting on November 19th at the International House in New Orleans. Plans were formulated for a drive for charter members, and committees were appointed as follows: Membership, Constitution and By-Laws, Charter, Program and Publicity.

New York—G. P. Dixon, Pres.

The Board of Directors of the New York Chapter met on November 16th in the Seventh Regiment Armory. The proposed new Constitution and By-Laws were approved for submission to the chapter membership. Committee chairmen were appointed as follows: Armed Forces—Capt. David R. Hull; Financial—Comdr. W. L. Peel; Industrial Relations—Dr. Orestes Caldwell; Liaison—Mr. George W. Bailey; Meetings—Capt. W. G. H. Finch; Membership—Mr. Lee L. Glezen; Publicity — Lt. Col. Ralph G. Edwards; Reserve Affairs —Lt. Col. James A. Mylod. After discussion of the proposed functions of the Industrial Relations Committee, it was unanimously agreed that the chapter could best assist Industry and the Armed Forces towards solution of mutual problems by acting in a liaison capacity between them. The varied civilian and military contacts in the communications and photographic fields available to the chapter will provide effective channels through which representatives of Industry and the Armed Forces may be assisted in obtaining the most direct contacts with one another for the discussion of specific problems.

Plans were made for the chapter to

hold a joint meeting with the Volunteer Electronics Warfare Division of the Naval Reserve on February 15th.

The regular meeting of the New York Chapter was held on December 15th at the Seventh Regiment Armory. The members voted to accept the new Chapter Constitution and By-Laws, which had been approved by National Headquarters, and selected the following representatives for the National Council: George P. Dixon, Ralph G. Edwards, Theodore N. Pope, William H. Harrington, George W. Bailey, David R. Hull, and W. H. Rivers.

The program featured a most interesting demonstration by engineers of the New York Telephone Company on "High Waves of Communications." Mr. Leslie R. Blasius, Service Engineer, used small scale replicas of the transmitter receiver stations that are now operating on seven hilltops between New York and Boston and are being constructed to link Chicago and New York with a microwave relay system. This system is designed, through the use of various frequencies, to carry television network programs and hundreds of simultaneous long distance calls. The demonstration included the actual transmission of speech and music over a microwave beam.

The January 6th meeting of the chapter was held at SC Photo Center, L. I. City, as a joint meeting with the Atlantic Coast Section of the Society of Motion Picture Engineers. Details will appear in the next issue.

Pittsburgh—F. E. Leib, Pres.

On October 29th, the Pittsburgh Chapter joined with the Signal Corps Unit Instructor of the Western Pennsylvania Military District in presenting a talk by Col. Arthur Pulsifer, Signal Officer of the Second Army. Col. Pulsifer discussed new developments in other services, and outlined a fundamental plan for the Signal Corps in the event of a future war on foreign soil, picturing the types of communications systems required from the Zone of the Interior through Theater, Group, Army, Corps, Divition, and Regimental headquarters.

On November 9th, the regular meeting of the chapter was devoted to Problem No. 1, "The Conversion of Industry from Peacetime Operation to Wartime Controls," submitted by the National Advisory Committee. Mr. Robert R. Ridley, Manager of Orders, Copperweld Steel Co., spoke on the development of plans for control of materials during World War II and outlined the types of control which would be desirable in the event of a future war. Mr. Ralph W. Will, Manager of Radio Sales, Hamburg Bros., described his experiences as a Signal Corps materiel expeditor during World War II and mentioned some of the difficulties encountered by manufacturers of communications equipment. Mr. F. E. Leib was elected to the National Council.

The Copperweld Steel Company, Glassport, was host to the chapter at its December 14th meeting. After a dinner in the Copperweld Cafeteria, the members were taken on a tour of the main Copperweld plant.

Richmond—E. T. Maben, Pres.

The December meeting of the chapter was held at the John Marshall Hotel on December 7th. The program featured two speakers from Camp Lee: Maj. R. C. Hummell, Signal Officer, who gave a short talk on Army communications; and Lt. Col. John A. Spencer, Executive Officer, Quartermaster Training, whose subject was "The Use of Photography in Visual Education."

Sacramento—L. J. Brundige, Pres. and National Council member

The November 3rd meeting, held in the Sacramento Signal Depot, was attended by 82 members and guests. The official guests of the evening were members of the Sacramento Signal Depot Radio Club. After seeing two Army films — "Tale of Two Cities" and "The Atomic Bomb"—the group moved to the Post Cafeteria for dinner. Lt. Col. F. C. Butler, newly appointed Commanding Officer of the Depot, welcomed the members to the Post. The activities of the Radio Club were described by Mr. Xelis W. Godfrey, its President. Capt. Ernest A. Greeson, 146th Aircraft Control and Warning Squadron, announced the new National Guard organization with headquarters at Camp Kohler.

The lecture given by Dr. Otto J. M. Smith, University of California, on "Russia's Bomb" was well received.

Lt. Col. George H. Melvin, Jr., who has done such an outstanding job as Executive Secretary of the chapter since its inception, has been assigned to active duty in the East. Maj. James A. Board has been appointed his successor.

St. Louis—G. E. Popkess, Pres.

At a recent meeting, Col. Popkess was elected to represent the chapter on the National Council.

Seattle—F. W. Kerr, Pres.

A dinner meeting was held on November 30th at the American Legion Post #1. The feature of the evening was a talk and demonstration on Loran receivers by Messrs. Thompson and Wakefield of the Sperry Gyroscope Company. Col. Fred P. Andrews was elected to the National Council.

Southern California—H. W. Hitchcock, Pres.

Chapter members met on November 18th at the KMPC Studio, Los Angeles, to hear Arthur C. Hohmann, Deputy Chief of Police, Los Angeles, speak on "Local Preparations for an International Conflict." Kenneth B. Lambert, of MGM, was elected Secretary-Treasurer of the Chapter.

★

STUDENT CHAPTERS

New York University

The winner of A.F.C.A.'s annual award for the outstanding military student has already been selected. His name will appear in a later issue in connection with the presentation of the award which is expected to be made by Colonel Dixon, president of the New York Chapter. Much interest has been created by A.F.C.A.'s essay contest. The Signal Corps instructor is holding a special class preparing the contestants, by requiring them to write shorter essays.

Oklahoma A. & M. Chapter

At the regular monthly meeting with the president, G. E. Thurmond, presiding, held on December 9th, it was decided to change the meeting to the second Thursday of each month and to have every third meeting preceded by a dinner. Professor Betts was chosen as the new faculty advisor. He was the principal speaker at the meeting and outlined the life of an engineer in our times. Eugene Lawley is expected to start a class soon in the Morse code by sound and light.

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NEWS—SERVICES and INDUSTRY

General

Electronics Committee's First Meeting

Mobilization planning by the Electronics Equipment Industry Advisory Committee, which has been established jointly by the National Security Resources Board and the Munitions Board, in the first meeting of the organization November 16 was successfully launched in the covering of a ten-point agenda and the election of joint chairmen of the group —for industry, F. R. Lack, Director of AFCA, Chairman of its National Advisory Committee, and Vice President of the Western Electric Co.; for the Government, Captain W. C. Wade, USN, Chief of the Facilities Division, Munitions Board.

In addition to twenty-three executives of electronics manufacturing concerns, the meeting was attended by representatives of the Army, Navy, Air Force, NSRB and the Munitions Board.

The co-chairmen of the Electronics Equipment Industry Advisory Committee, Mr. Lack and Captain Wade, outlined for the group the requirements for government-industry cooperation in the mobilization planning and it was stressed throughout the meeting that in the formulation of such plans the entire electronics industry would be utilized — large, medium and small manufacturers. Mr. Lack detailed the Radio Manufacturers Associations' mobilization plan which has been under study for some months by the armed services.

Promptly putting the committee on a "task force" basis, the industry representatives at the meeting decided to appoint a special committee at a later date to assist in standardization of military specifications and nomenclature. This committee, it is planned, will work with the joint Army-Navy-Air Force Standards Agency at Fort Monmouth, N. J. In addition, Mr. Lack will also appoint other committees to work on various components of the overall mobilization "master" plan.

In addition to the discussions of requirements of such planning by Mr. Lack and Captain Wade, the viewpoint of the government on electronics mobilization was presented at the Nov. 16 meeting by Major General Patrick M. Timberlake, USAF, Military Director for Requirements and Facilities of the Munitions Board; Leighton H. Peebles, Communications Director of the NSRB; and Captain C. A. Rumble, USN, chief of electronics under the Deputy Chief of Naval Operations for logistics. Ray C. Ellis, Chairman of AFCA's Advisory Committee on Components Manufacture, and Executive Vice President of the Raytheon Manufacturing Co., reviewed the electronics manufacturing task committee report to the NSRB.

Equipment Committee Meets

The Electronics Equipment Industry Advisory Committee, which was established jointly by the National Security Resources Board and the Munitions Board, met for the first time in Washington, D. C.

Membership of the committee consists of 28 representatives from large, medium and small electronics companies.

The advisory group was organized to advise the Munitions Board and the National Security Resources Board on industrial mobilization plans for the electronics equipment industry, and related problems.

Subcommittees composed of members from the industry and from the Government will be organized to work on special subjects.

Subsequent meetings will be at the call of the Munitions Board.

Membership of the committee, the majority of whom are from group members of AFCA, is as follows:

Dr. W. R. G. Baker, Vice Pres., General Electric Co.
Mr. Frank N. Folsom, Pres., Radio Corporation of America
Mr. F. R. Lack, Vice Pres., Western Electric Co., Inc.
Mr. Walter Evans, Vice Pres., Westinghouse Electric Corp.
Mr. David W. P. Hilliard, Gen. Mgr., Bendix Radio Div. of Bendix Corp.
Mr. W. J. Halligan, Pres., Hallicrafters Co.
Mr. W. A. MacDonald, Pres., Hazeltine Electronics Corp.
Mr. J. Ballantyne, Pres., Philco Corporation
Mr. Paul V. Galvin, Pres., Motorola Incorporated
Mr. David Hull, Vice Pres., Federal Tel. & Radio Corp.
Mr. Ray C. Ellis, Vice Pres., Raytheon Mfg. Corp.
Mr. Max F. Balcom, Vice Pres., Sylvania Electric Products
Mr. George Wright, Vice Pres., Bliley Electric Co.
Mr. H. A. Ehle, Vice Pres., International Resistance Co.
Mr. H. L. Hoffman, Pres., Hoffman Radio Corp.
Mr. R. C. Sprague, Pres., Sprague Electric Co.
Mr. J. H. Miller, Vice Pres., Weston Electrical Instrument Co.
Mr. R. O. Driver, Pres., Wilbur B. Driver Co.
Mr. Jerome J. Kahn, Pres., Standard Transformer Corp., Elston, Kedgie & Addison
Mr. S. W. Gilfillan, Pres., Gilfillan Bros., Inc.
Mr. Arthur E. Thiessen, Vice Pres., General Radio Company
Mr. A. D. Plamonden, Jr., Pres., Indiana Steel Products Co.
Mr. Monte Cohen, Vice Pres., F. W. Sickles Co.
Mr. C. A. Warden, Jr., Vice Pres., Superior Tube Co.
Mr. R. S. Bicknell, Vice Pres., American Lava Corp.
Mr. G. M. Gardner, Pres., Wells-Gardner Co.
Mr. Dwight R. G. Palmer, Pres., General Cable Corp.

Lack Speaks at Baltimore

"Spreading the know-how" of electronics equipment manufacture and production was the theme of an address by Mr. Fred Lack, vice president in charge of the radio division of the Western Electric Company, before Signal Corps depot commanders and procurement personnel at the Baltimore Signal Depot in January.

Mr. Lack's talk was the feature and final event of a three-day meeting of all Army Signal depot commanders held at Baltimore January 17, 18, 19.

Mr. Lack has had long experience in dealing with the problems of electronics equipment as related to the national defense. Now chairman of the Munitions Board's Electronics Equipment Industry Advisory Committee, he was director, during World War II, of the Army-Navy Electronics Production Agency. He is also a director of the Armed Forces Communications Association and heads the association's national advisory committee on manufacturing.

Budget Boosts for Services' Electronics & Communications

The funds for electronics procurement by the Signal Corps, Air Force, and Navy in the President's budget, presented to Congress January 10, showed several major increases.

The Air Force budget for electronics procurement would be increased, if Congress gives approval, from $53.3 million in the current fiscal year to $115 million.

For the Signal Corps the fund would be $207.4 million, including a previously-approved contract authorization fund. Direct procurement of electronics and communications equipment, not including the contract authorizations, was estimated at $60 million.

The Navy Bureau of Ships showed an increase of $3.2 million, including reimbursable amounts, for electronics, as well as a boost in the overall research and development funds. Total funds for Navy electronics procurement, both Bureau of Ships and Bureau of Aeronautics, were set in the budget at $72.9 million.

Communications Facilities Exhibited for Inaugural Visitors

Exhibitions of communications facilities were displayed by the Signal Corps, the Air Force, the Airways and Air Communications Service and the Coast Guard at the Washington Memorial Grounds in conjunction with the Inaugural ceremonies. The equipment set up for view of the crowds in the capital city included mobile communications centers, radio-equipped weather reporting stations and radiotelephone facilities.

The Signal Corps equipment included a match-box size radio set, new facilities for a communications center mounted in three vans, handi-talkies and radar.

The Coast Guard had on exhibition a communications truck equipped with four-channel radio sets, a radio-teletype and other equipment which has been used for emergency communications during floods and other disasters and ship-research radar, used both for detection of aircraft and surface craft.

The AACS equipment included teletype and facsimile equipment used during World War II as well as new developments in such equipment. The Air Force, in addition, had a mobile weather reporting station on exhibition with facsimile equipment, in actual operation, for receiving wirephoto weather charts and analyses.

The exhibits attracted a great deal of attention since the public was allowed to operate some equipment in a wide variety of fields. And viewers saw how radar, for example, in actual operation is used for the detection of the approach of aircraft, and for the automatic control of searchlights employed in air defense.

Exhibits for the Signal Corps were brought from the Engineering Laboratories and the Signal School at Fort Monmouth, N. J., while the Coast Guard equipment was brought into Washington from Alabama where some of the equipment was used in recent floods there. The AACS and Air Force exhibits came from Andrews Field, near Washington.

Procurement System Plan

The formation of an eight-member task group of the Electronics Equipment Manufacturing Industry Advisory Committee to make a comprehensive study of the mobilization production plans of the Radio Manufacturers Association, and the Signal Corps - Navy - Air Force Contingent Contract Plan to formulate an overall defense preparedness-war emergency military procurement-production blueprint, marks an important step forward in the mobilization planning of the armed services and the electronics - radio manufacturing industry. The two plans previously had been submitted to the AFCA Board of Directors for comment and their recommendations have been sent to the task committee chairman, Mr. G. M. Gardner of Chicago.

The formation of the manufacturers' task committee to formulate an overall procurement system for the armed services was made known to the top officers of the Signal Corps, Navy Electronics Division and Air Force concerned with this sphere. The goal will be to reconcile the differences between the RMA and contingent contract plans and to come up with an overall program.

New Pack Set

Pack Set Type 1810 is a new addition to the Link Radio line of communication equipment. It is basically a 30-44 megacycle pack set and has been designed to fulfill the need for lightweight portable equipment, but

NATURE'S "BOMB"

This is not a photograph of an atomic bomb explosion. A few weeks ago Major General Floyd Parks, the Army's deputy commander in the Pacific, was flying over Bougainville in the Solomons on a trip from headquarters in Hawaii. He directed his pilot to fly past 6500-foot Mt. Bagara, an active volcano. As the plane neared the summit, the volcano suddenly "blew its top," spilling rivers of lava down the mountainside and sending an ashen cloud six miles into the air. General Parks—an amateur photographer—got this picture and his pilot took some motion pictures in color. (Courtesy LIFE Magazine)

may also be used for low-power base stations requiring self-contained power sources. Serviceability, long battery life and economical operation have not been sacrificed to achieve minimum weight and size. Instead. the set features the use of readily-obtained low-cost tubes, easily-serviced standard components, standard long-life dry batteries, and a mechanical design that permits easy servicing by established methods.

Pack Set Type 1810 weighs 15½ lbs. complete with batteries, carrying straps, handset, and 37" whip antenna. In the 11¾" x 10 9/16" x 4 11/16" weatherproof carrying case are housed an 8-tube crystal-controlled FM transmitter, a 12-tube crystal-controlled FM receiver, and batteries sufficient for approximately 25 hours of intermittent transmitting and receiving service. Three separate adjustable carrying straps are supplied which enable the set to be carried comfortably on the back, slung from one shoulder, or carried by hand. For portable operation, two types of antenna are available. One is a 37" which may be used for short range communication and where operation while being carried is necessary. A

coupling unit, available as an accessory, permits connecting the set to a coaxial transmission line when it is desirable to locate the antenna some distance from the transmitter-receiver unit.

Secret Signalling System

A U. S. patent, covering a secret signalling system by which ordinary messages are converted to a succession of arbitrary symbols and transmitted by facsimile or television to a receiving and decoding terminal, has been issued to Brig. General David Sarnoff, president of AFCA and chairman of the board of the Radio Corporation of America.

In one form of the invention, use is made of a special typewriter which prints pictorial characters or any arbitrarily chosen symbols instead of the common letters of the alphabet. After a message comprising the symbols has been transmitted by radio facsimile or television to the receiving terminal, it may be decoded either manually or automatically by alternate means revealed in the patent papers.

Under the manual method of translation at the receiver, an operator, using a typewriter equipped with keys carrying the symbols, reads the characters, depresses the proper keys and converts the message to its original text. The patent explains that sender and addressee, by prearrangement, may change the combination of symbols as often as necessary to insure secrecy, even when transmitted by a common radio carrier.

New Tools for New Era

The Geiger counter, heretofore a hand-made device put together by the physicist interested in studying cosmic radiation or searching for misplaced radium, is being readied for mass production. Developments are under way at Westinghouse that will lead to economical precision manufacturing of tubes, instruments, and power supplies for Geiger counters by the tens of thousands, like components of radio receivers.

A grim need is that of the military forces as they take the possibility of atomic warfare into account. If this country should be attacked by any one of many conceivable weapons—atomic-energy bombs, radioactive dust, or an infiltration of radiation-poison packages, large quantities of detectors would be required throughout highly populated areas. It is a dour thought — but a radiation detector may be standard equipment for the civilian-defense crewman of the future.

Electronics Computer Uses

Possible uses for electronic computers in the military services will be looked into by a special committee which has been organized by the Munitions Board, National Military Establishment.

Representatives of the Army Comptroller's Office, the Chief of Naval Materiel, the Deputy Chief of Staff, Materiel, Air Force, and the Research and Development Board will compose the committee.

This group will act primarily as a central clearing house to assist the Services in determining the potential value of electronic computers in speeding up activities in which the Munitions Board has an interest.

The board is particularly interested in the possibility of using the computers to shorten the time now required by the Military Services to make computations of manpower and materiel requirements necessary to carry out plans of the Joint Chiefs of Staff. These compilations deal with millions of items and now require months of hard work. When the calculations are completed, they then go to the Munitions Board, which looks at them from the standpoint of the ability of industry to produce the materiel needed. Any shortening of the time required to compute those requirements will hasten the entire planning process.

Communications in Germany

That American soldiers stationed in Germany can reach their families at home within a few hours by phone or cable is in large part due to the work of Mr. Chase E. Laurendine, President of AFCA's European chapter, who is presently serving in Frankfurt, Germany, as U. S. Military Government Telecommunications Officer for the combined U. S. and British occupation zones.

Mr. Laurendine, who advises the German Post on all matters pertaining to the restoration and maintenance of wire and radio telegraph communications, belongs to one of the smallest of the Military Government control groups functioning in Germany today. Yet in no other phase of German economic life has recovery been so complete as in the field of communications.

From a complete breakdown at the end of the war in 1945, all pre-occupation Reichspost services have now been fully restored. In May 1945 the U. S. Army Signal Corps had complete control of the entire communication network in southeastern Germany. The German communications system had collapsed to such an extent that it was virtually impossible for a Berlin family to contact a relative in Munich. MG officers realized that immediate rehabilitation of the German postal and telegraph services was vital to the recovery not only of Germany but of the whole European economy as well.

The process of restoring communications and turning back control and operation of these facilities to competent German authorities was an enormous task which has been accomplished in an almost unbelievably short time.

First came restoration of Germany's internal communications. Some 2,500 miles of telephone and telegraph wire lines which had formerly been maintained by the U. S. and British armies were turned over to German Post control in November 1946. Five months later international telegraph service was resumed between Germany and the rest of the world. Outgoing international airmail service was authorized for the first time since the war last spring, and now, also for the first time since 1939, postal service is available between Western Germany and all countries in the world. Today it's even possible to put a call through to the Queen Elizabeth or the Queen Mary from Germany.

At a time when most phases of the German economy were limping along, at from one quarter to one half their prewar capacity, the volume of traffic handled by the Deutsche Post was as great if not greater than before the war. That the old Deutch Post, with its badly worn and overloaded equipment, has been able to carry not only as much but even more traffic than in 1938 is a tribute to the able direction and supervision of the handful of British and U. S. communications experts.

AIR FORCE

AACS Chief Gets a Star

Wallace G. Smith, one of the pioneers in Air Corps communications, was promoted to the grade of Brigadier General in December shortly af-

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Brig. Gen. Wallace G. Smith
Commanding Officer, AACS.

ter his assignment to command the Airways & Air Communications Service. General Smith was one of those who laid the foundations for and built up the highways of communications that helped make the great Air Force victories in World War II possible. He has played a prominent part in building the present AACS to its high state of efficiency as an instrument of National security. His first service was as an enlisted man in the Signal Corps, followed in a few months by a commission in 1918 in the old Air Service. He graduated from the Air Service Communications School in 1921, took a postgraduate course in communication engineering at Yale University 1923-4, and later graduated from the Air Tactical School.

Communications & Electronics Emphasized in Symington Report; Stresses Radar "Fence"

The indispensability and vital importance of communications and electronic developments in aviation, particularly in military flying, were depicted in considerable detail and emphasized in the first annual report of Secretary W. Stuart Symington of the Air Force. In numerous sections of Secretary Symington's report, the different functional uses of communications and electronic developments, both in flight operations and in combat weapon uses—especially guided missiles—were brought out by Secretary Symington.

Secretary Symington's report—337 pages long—was evidently presented to Congress in support of the demand for a strong and well-equipped military aviation service for the nation's defense. The Air Force Secretary stated that since this was the first annual report of the Department of the Air Force, "more detail has been included than may be considered appropriate in the future."

Backing up the recommendation of Secretary of Defense Forrestal for an adequate "radar fence" for the continental United States, a proposal which has already been given impetus in Congress through measures of Chairman Tydings and Chairman Vinson, respectively of the Senate and House Armed Services Committees, Secretary Symington placed under the heading of "unsatisfactory progress" a brief four-paragraph exposition of aircraft and control warning systems, which he termed as inadequate, and recommended "top legislative priority consideration." His report cited that the first requisite of defense of the United States is a system of aircraft detection at long range so our own intercepting aircraft can attack the invaders. Noting that such a system was a key to success in the battle of Britain, the Secretary said this requires "extensive radar and radio installations and complex control centers."

The Director of Air Communications had a summation of his activities in the Air Force Headquarters and stated that based on the overall requirements for communications and electronic equipment and facilities, the Air Force had asked for $185,760,000 in the fiscal year 1948 but the funds appropriated, $57,430,000 had been less than 1/3 the amount required. This reduction was exceptionally serious in the fiscal year ended June 30, 1948 because of the increased unit cost of equipment. The Director of Communications emphasized that during the 1948 fiscal year his office and staff had taken over many of the responsibilities of Air Force Communications which previously reposed, at least in title, in the Army.

"In general, the procurement programs," the Director of Communications reported, "drawn up in the field of communications and electronics are planned to provide the equipment required for the operation and control of aircraft under any condition of weather and visibility, during defensive or offensive operations, in support of ground and surface operations, and in joint operations with the Army and Navy. Programs for specific types of equipment to fulfill these specific communications functions were phased over periods of time ranging from 3 to 6 years." The Air Force Director of Communications recorded that at the beginning of the 1948 fiscal year the command communications network of the Air Force consisted of systems left over from World War II and these systems had deteriorated through wear and tear and reduced maintenance resulting from the rapid demobilization and maintenance personnel.

Even though no funds were appropriated in the 1948 fiscal year to modernize or replace this system's equipment, the Director and his staff during this period redesigned and relocated the system to meet more nearly the requirements of the U. S. Air Force. But the system is inadequate for expanding AF operations and "does not meet the requirement for Air Force communications to cope with the problems of high-speed, long-range, all-weather aircraft operating on a global basis," the Director said. His report added that efficient air-traffic control had been hampered by lack of adequate short-distance navigational aids and to provide a modern short-distance navigation system procurement action was initiated on the new VHF navigation receiver. In congested areas procurement action has been initiated on air surveillance radar and precision radar equipment to provide guidance on final approach to work in conjunction with surveillance radar. For long-distance navigation aids, a low-frequency loran chain has been installed for test purposes.

For the Strategic Air Command in the 1948 fiscal year electronics assumed ever-increasing importance. Over 15 different types of aircraft equipment for locating and jamming enemy radio and radar are at present being supplied to groups of the SAC and installed. Much time has been devoted to obtaining and installing VHF radio communications in all aircraft and nearly all of the supply and technical problems connected with this job have now been solved. The SAC has also developed a program for reducing electrical interference with communications and methods for reducing static and increasing range have been put into effect.

The technique of operating a global Air Force through contact with aircraft on extended flights that had been adopted by the SAC is transmitting on different frequencies in order to overcome the effects of fad-

Mercury, "messenger of the gods," was slow compared with Ultrafax—which moves at the speed of light.

This messenger *delivers a million words a minute*

Recently, at the Library of Congress, a distinguished audience saw documents flashed across Washington by a new means of communication . . . and reproduced *in facsimile.*

This was Ultrafax in action—a super-fast television communications system developed at RCA Laboratories. Reproductions of *any* mail—personal, business, or military . . . including police descriptions, fingerprints, bank drafts, government records—can travel at 186,000 miles a second!

Material to be sent is placed before an RCA "flying spot" scanner, and transmitted by ultra-high frequency radio signals. Miles away the pictures appear on a picture tube and are photographed. Negatives are ready for printing or projection in 40 seconds.

Eventually, when Ultrafax comes into commercial use, a complete Sunday paper—every word, every picture—may cross America in 60 seconds . . . a letter in the twinkling of an eye.

Science at work . . .

Ultrafax is but *one* of scores of major achievements pioneered at RCA Laboratories. This leadership in science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

• • •

Examples of the newest developments in radio, television, and electronics may be seen in action *at RCA Exhibition Hall, 36 West 49th Street, N.Y. Admission is free. Radio Corporation of America, Radio City, N. Y. 20.*

RCA

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World Leader in Radio — First in Television

ing due to range and unfavorable "skip-distance." Rotary beam antenna arrays are used on the two higher frequencies with excellent results. The problem of transmitting over long distances from aircraft, however, remains unsolved.

In order to receive replies from aircraft at considerable distances, arrangements have been made with the Airways and Air Communications Service for relay of traffic on the two higher frequencies by the establishment of key AACS stations which operate on SAC frequencies. Other communications projects which received considerable attention during the year included Fox Broadcast experimentations, buildup and improvement of radar maintenance, establishment of TWX service, ship-to-shore telephone communication for command aircraft, extension and improvement of base telephone systems, improvement of point-to-point radio with strong emphasis on radio teletype, and obtaining on-line secrecy equipment.

The report of Chief of Staff of the Air Force, Gen. Vanderberg, listed the progress in electronics for military aircraft. His report cited the high-precision air-borne system to provide precision navigation and accurate bombing through the overcast; ground radar which is being developed to make this equipment as automatic as possible thereby reducing time delays due to the human element which is essential in the present time of jet aircraft and guided missiles; the navigation aids under the RTCA system which will require five years for the first phase and fifteen years for entire completion; and lightweight air-borne television equipment which has been developed by the Air Force and can be installed in a remotely controlled crew-less aircraft to transmit to the guiding aircraft instantaneous visual pictures of the control panel and of the view ahead. The Air Materiel Command had an interesting reference to the Westinghouse "stratovision" tests for increasing television range.

The main achievements of the Airways and Air Communications Service during the 1948 fiscal period were the establishment of a low frequency loran chain in the Arctic; the activation of an Air Force communications center in the USAF Headquarters; the integration of Naval Air Stations into the Military Flight Service Communications System; the expansion of the Ground Control Approach program; and the implementation of a tape-relay program to facilitate traffic handling, particularly along interservice circuits. On July 1, 1947, the beginning of the fiscal year, the AACS had 11,241 personnel operating 238 stations with 1,083 facilities and at the end of the 1948 fiscal period AACS operated 217 stations comprising 1,318 facilities with 15,915 personnel.

AACS First Decade

The Airways and Air Communications Service celebrated its 10th birthday 15 November. Brig. Gen. Wallace G. Smith, with headquarters in Washington, is the new commanding officer, having succeeded Major General Harold McClelland, who became Deputy Administrator MATS.

One of AACS's functions is furnishing communications and navigational aids to "Operations Vittles" in Germany. Vittles traffic has so increased AACS's activities that the service has had to expand its existing facilities in Europe in order to support the operation and still provide its services for other flights—flights which range from Wiesbaden, Germany, to Dhahran in Saudi Arabia. In addition to this accelerated expansion, AACS at the same time reopened the Rome, Athens and Tripoli airways routes.

The Airways and Air Communications Service is global in operation and unified in management. It is composed of an 1800 Wing covering the continental U. S., an 1807 Wing stretching from Wiesbaden, Germany, to Dhahran in Saudi Arabia, an 1808 Wing embracing the Pacific, an 1804 Group in Alaska, an 1805 Group covering the North Atlantic, and an 1806 Group in the Caribbean.

Messages of greetings were sent to the AAC Service by General Smith, who expressed his pride "in the men who have built these electronic tracks in the sky." General of the Army H. H. Arnold congratulated the Service and said: "You already have accomplished what, to the layman, seems the incredible; and yet I am sure you realize you have but just begun to tap your possibilities."

AF School Goes Co-ed

The U. S. Air Force's Officer Candidate School at Lackland Air Force Base, San Antonio, Texas, became coeducational on January 10 when the first group of WAF officer candidates began training, taking the same courses as male officer candidates and attending classes with them.

A quota of 25 WAF candidates and 250 men was established for the January OCS class, which will last six months. All officer candidates, both men and women, completing the course will be commissioned as second lieutenants in the Air Force Reserve and ordered to active duty for a period of three years. They will be offered opportunity to apply for regular Air Force commissions during this tour of duty.

This will be the first time the Air Force has trained its own women officers, or that they have been trained with men. During World War II all WAC training, with the exception of specialized technical courses, was conducted by the Army, separate from the male training program.

The WAF officer candidates will study the normal OCS curriculum, including administration, Air Force organization, supply, military law, field sanitation, etc. A course in field service, requiring extensive field maneuvers, will be omitted for women officer candidates.

Entrance qualifications are the same for men and women. Entrants must be at least 20½ years old but not over 26½ years old, have at least two years of college or pass an equivalent examination, be of high moral character, a citizen of the United States, and agree to serve at least three years upon completion of the course of training unless sooner relieved.

OCS candidates will be accepted from both civil and military life and will hold at least a grade of staff sergeant during the training program. An applicant with a military grade higher than stff sergeant upon entering the course will retain that grade throughout the course. Candidates lower than staff sergeant will be promoted to that grade.

If an OCS student entering the course from civil life fails to graduate, the student will be discharged from the Air Force. If an unsuccessful candidate enters from a military assignment, the student will return to his former grade and complete the normal enlistment period.

Rescue Aided by "Ham" Radio

In the rescue of the airmen downed on a Greenland ice cap the Air Rescue Service maintained essential voice communication between Washington and a Labrador outpost

through two military amateur radio stations.

Through K4USA, a military amateur station recently installed by the Signal Corps at the Pentagon in connection with the activation of a military amateur radio system, officers of the Air Rescue Service were in day-by-day contact with VO6AN at Goose Bay, Labrador, where rescue efforts were directed. They exchanged information and advice, evaluated the problem in terms of daily weather conditions, and ordered special equipment flown from widely separated areas to assist in the rescue.

Rescue officers in Washington stressed the value of the conversational exchange in reaching quick decisions. K4USA was able to contact VO6AN within an hour after a request was made by the Air Rescue Service.

The Military Amateur Radio System, a joint Army-Air Force project to encourage radio training in the country, was activated November 26. K4USA — the Signal Corps station which will operate as net control on special frequencies under MARS with the Army call WAR—has been on the air somewhat longer.

Beacon on the Rhein

"Die Wacht am Rhein," the stone colossus which stares with sightless eyes across the ancient Rhein valley has been joined by a more useful—if less ornamental—sentinel.

The silent "Watch on the Rhein" (1883, by Joseph Schilling) has a voluble rival in a radio installation known as the "Rudesheim Beacon" (1948, by Airways & Air Communications Service).

The beacon guides "Operation Vittles" pilots in an approach to the Wiesbaden landing field. It is located near the 118-foot National Monument on the slopes of the Niederwald amid terraced vineyards.

The Rudesheim beacon is one of 17 which were placed on the air within a three-week period by AACS to service the busy air corridors to and from Berlin.

AACS Cross-training Pays Off

Cross-training, an old habit with Airways & Air Communications Service, is paying rich dividends in the "Vittles" Airlift.

AACS men with dual and triple skills are doubling up on "Vittles" jobs to meet the explosive expansion of service demanded by the abrupt launching of the Airlift.

Control tower and ground-to-plane operators learn each other's jobs, radio mechanics move on into the fields of radar and newcomers are coached in radio by the veterans.

A good example of the benefits of this cross-training is the case of T/Sgt. Walter J. Mysona, of Cleveland, and his control tower class. Although his Wiesbaden control tower was faced with the zooming traffic of the Airlift, T/Sgt. Mysona set up a simulated control tower and began teaching a class of 21 men.

Within the short period of three weeks, T/Sgt. Mysona and his instructors turned out enough operators to ease the talent-drought in the towers. Training officers say that T/Sgt. Mysona's intensive school was one of the best that has ever come to their attention.

Airlift Figures Jam Charts

Among the unsung casualties of the airlift: statistical charts.

Those beautiful multi-lined jobs which do so much for the blank walls of a bleak office have taken a real beating from the airlift.

The lines on the graphs were moving along at an even keel, and then came June 26—the beginning of the airlift.

The markers tilted upward, and then began to climb like F-84 jets. They ran off the graphs and headed for the ceiling as the Berlin air corridors became the most concentrated air operation the world has seen.

So the old charts have been retired, and new ones have been installed to care for such Airways & Air Communications Service figures as these: a ground-aircraft radio contact every 15 seconds around the clock; a radio tower contact every minute at Tempelhof airdrome in Berlin; and 3,000 radar blind-landings at Wiesbaden within a month.

U. S. Techs at Tegel Field

Many of the technicians at the new Tegel Air Field, French Zone, Berlin, are Americans.

Wherever the USAF operates the men of Airways & Air Communications Service arrive early and leave late. Brand new Tegel is no exception to this rule.

Approximately 50 AACS specialists have been assigned to Tegel to handle the radio control tower, approach control, teletype to Tempelhof Air Field, radio circuit to Tempelhof, weather circuits and Ground Controlled Approach.

"Fog & Smog" Club

"Fog-and-smoggers" is the new name for Vittles pilots who have to make blind-landings in the extremely soupy winter weather.

When an airbridge pilot makes a radar (GCA) controlled landing in weather below normal instrument minimums he becomes a member of the "Fog and Smog" flying club.

"Fog and Smog" membership cards, attractively printed with a GCA unit for a background, certify the date, location and circumstances under which the radar blind-landing was accomplished.

The calling-card sized tickets are handed to the pilot immediately after a difficult landing.

These souvenirs of a tough job on the Vittles run are prepared by Airways & Air Communications Service which operates GCA for the Air Force.

Key Personnel Changes

Colonel Elton Hammond, from Signal Officer, Third Army, to Chief, Personnel and Training Service, OC SigO. Principal WW II duty, Signal Officer, Third Army.

Colonel Grant Williams, from Signal Officer, Fifth Army, to retirement. Principal WW II duty, Signal Officer, Fifth Army.

Colonel Edward A. Allen, from I Corps to Headquarters, Fort Monmouth. Principal WW II duty, Signal Officer, Hq XXII Corps, ETO.

Colonel George F. Wooley, Jr., from OCSigO to EuCom. Principal WW II duty, Signal Officer, Seventh Army.

Colonel Clarke W. Carter, from Intelligence Div. GS, USA, to Army Security Agency, Washington, D. C., for duty as Chief.

Colonel Marion Van Voorst, from P and T Div., OCSigO to Personnel and Administration Div., GS, USA.

Colonel Eugene V. Elder, from Sig. Div. EuCom, to Walter Reed General Hospital, Washington, D. C.

Colonel David E. Washburn, from US Forces, Austria, to Walter Reed General Hospital, Washington, D. C.

Colonel Thomas H. Maddocks, from Headquarters, Third Army, to US Forces, Austria, for duty as Signal Officer.

Colonel Percival Wakeman to First Army. Principal WW II duty, Director of Communications, Hq., ETO.

Colonel Reginald P. Lyman, from Fort Monmouth to Camp Gordon.

Colonel Albert J. Mandelbaum, from the Signal School, and Director Signal Corps Publications Agency, to 13 weeks TDY Advance Management Course, Harvard University, effective 23 February 1949.

Colonel John L. Autrey, from D/A Personnel Records Board to I Corps for duty as Signal Officer.

Colonel Albert M. Pigg, from Army Advisory Group, China, to I Corps.

NAVY

Picket Submarines

With the Navy's announcement that its first picket submarine is on active duty there is opened up for speculation the possibility that all Navy radar picket vessels may eventually be submarines.

The submarine radar picket is presently experimental. Especial conversion of submarines is necessary to fit them for picket use. Such duty requires long cruising range and endurance, and highly sensitive radar equipment. The *Tigrone*, now on active duty, was fitted with the "Schnorkel," German breathing device which enables submarines to remain submerged for indefinite periods and to cruise submerged, using Diesels.

The usefulness of the picket vessel was highlighted a year ago when the termination of the U. S.-Panama agreement forced the Air Force to withdraw from its Panamanian radar bases (microwave early warning stations) and the Navy took over the bases' function with picket vessels in the Panama Canal area.

Akers, Navy Aviation Radio Expert, Promoted

Rated as one of the leading aviation radio experts in the Navy, Captain Frank Akers, who is now commander of the Carrier Division 15 of the Pacific Fleet, was one of 24 Navy officers selected for promotion to the rank of rear admiral by the Navy Department.

Captain Akers, who was understood to be the most closely associated with communications of the group of promoted officers, pioneered blind landing on carriers during the war.

Capt. Horne Assigned to CAA

Captain Charles F. Horne, USN, has been assigned for one year's duty as Special Assistant to the Administrator, Civil Aeronautics Administration, Department of Commerce.

Captain Horne's special assignment was made by the Navy at the request of the Administrator, D. W. Rentzel. He will have duties in connection with the government's program relating to all-weather navigation and landing systems.

In a letter to Secretary of the Navy John L. Sullivan expressing appreciation for Captain Horne's assignment, Secretary of Commerce Charles Sawyer cited the CAA's need for "an individual with a broad understanding of aviation needs, outstanding administration ability, and expert technical qualifications."

Captain Horne, until his new assignment, has been Deputy Chief of Naval Communications.

Electronics Research Chief

Dr. Karl R. Spangenberg, specialist in vacuum tube research, has been granted leave of absence from the Department of Electrical Engineering, Stanford University, Palo Alto, California, to become head of the Electronics Branch of the Office of Naval Research.

He will be charged with the planning, coordination and administration of an extensive program of electronics research for the Navy, which includes work in propagation, radiation and interaction with matter, electron ballistics, physics of components, circuitry, systems, and instrumentation.

Navy Rocket Radio

A tiny telemetering system weighing only a few pounds and capable of transmitting 24 different types of information simultaneously from a rocket traveling at nearly 3,000 miles an hour has been successfully tested by the Navy Department at White Sands, N. Mex.

Installed aboard the Navy's "Aerobee," the new unit functioned satisfactorily at an altitude of 71.78 miles above the earth at a maximum velocity of 2,830 miles an hour. The instrument radioed to recording instruments on the ground data concerning flight characteristics, motor performance, cosmic-ray intensity, quality of sunlight above the atmospheric blanket, and changes in the strength of the earth's magnetic field.

Underwater Photographs

A method of taking underwater photographs that reveal the flow patterns about surface vessels has been developed by the Experimental Towing Tank Laboratory of Stevens Institute of Technology. As a research tool, such photographs show promise of providing a valuable aid to the understanding of flow phenomena around a body. The method, similar to the "tuft" technique used in wind-tunnel and flight testing of aircraft, utilizes limp threads attached to the model itself, or to fine wires extending from it. Specifically, it can be employed in locating the optimum position of the rudder and the propeller and such appendages as bilge keels, scoops, overflow pipes and propeller struts or bossings.

SIGNAL CORPS

Balloon Altitude Record Set

Establishment of a balloon altitude record of 140,000 feet—20,000 higher than the previous maximum—is claimed by the Army Signal Corps.

The record was set by a specially built balloon flown by Evans Signal Laboratory, Belmar, New Jersey, in weather - forecasting and rocket - launching experiments. The Signal Corps designs meteorological equipment for the Army and Air Force, and pioneered in weather forecasting.

To reach the 140,000-foot mark, the record-setting balloon spent two and a half hours rising above the earth.

Lieutenant Colonel A. F. Cassevant, Evans Signal Laboratory director, who announced that the record was set on September 28, pointed out that the greatest height ever attained by a balloon carrying human beings was 72,395 feet. That was accomplished in 1933 by Captains Albert W. Stevens and Orvil A. Anderson. The balloon that rose 140,000 feet carried only meteorological instruments.

The Signal Corps is using high altitude balloons to carry delicate scientific instruments aloft in an investigation of the physical properties of the atmosphere in the relatively unexplored region between 100,000 and 150,000 feet. Better weather forecasting may be only one of the benefits resulting from the experiments. In addition, the data obtained will be used in connection with the launching of rockets.

The balloon which established the new world's record was developed under a Signal Corps contract by Molded Latex Products, Incorporated, of Paterson, New Jersey, with the assistance of Mr. Abraham Arnold of the Evans Signal Laboratory, one of the Signal Corps Engineering Laboratories.

The investigations are planned and directed by Dr. C. J. Brasefield, and are part of a broad program of upper atmosphere research being carried on at Fort Monmouth, New Jersey, under the general supervision of Dr. Michael Ference, Jr., chief of the Meteorological Branch of the Signal Corps Engineering Laboratories.

Sig School Graduation

Formal graduation services for 63 enlisted men from the Army Signal Corps School at Fort Monmouth, N. J.—the first ceremony of its kind held on the post for enlisted men—were held December 7, 1948. Brig. General Francis H. Lanahan, Jr., commanding general of Fort Monmouth, made the graduation address; and Capt. J. A. Anderson of the Signal School was master of ceremonies, and Chaplain T. P. Finnegan gave the invocation and benediction.

Similar services will be held for future graduating classes of enlisted men, school officials announced.

Training Film

The importance of making full and scientific use of training films after they have been produced was stressed at a recent conference on film utilization at the Signal Corps Photographic Center, Long Island City, New York. The session was attended by Army personnel from Washington, New York, and the six Army Area headquatrers, along with Navy and Air Force representatives concerned with the production, distribution and utilization of training films.

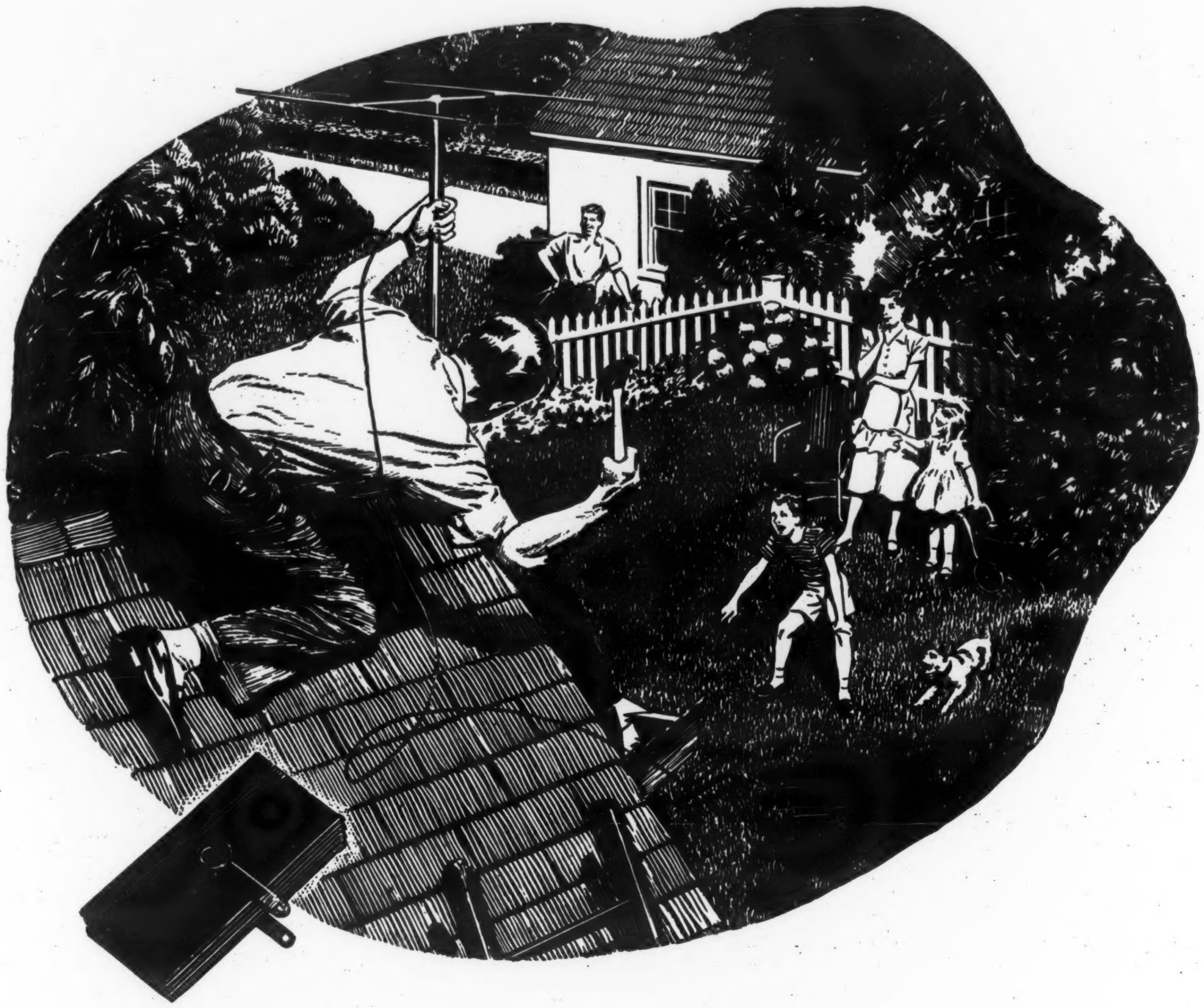
CSO Inspection Tour

Major General S. B. Akin, Chief Signal Officer of the Army, accompanied by Brigadier General Calvert H. Arnold, Chief, Procurement and Distribution Division, Office of the Chief Signal Officer, recently completed an inspection tour of Signal Corps depots in the Sixth Army Area, including the Sacramento Signal Depot, Sacramento, California, and the Signal Supply Section of the Utah General Distribution Depot, Ogden, Utah. General Akin also inspected the Alaska Communication System Headquarters at Seattle, Washington.

BETTER Television for MORE People

Federal's Miniature Selenium Rectifier makes low-cost, improved television possible

What's behind the smaller low-cost television sets that make it easy for more and more families to enjoy television today? It is Federal's Miniature Selenium Rectifier. This tiny unit eliminates heavy and expensive transformers, rectifier tubes and other components. Soon it will make possible even lower prices for 7- and 10-inch tube receivers . . . AC-DC television for the first time . . . amazingly compact AM-FM-TV combinations. The Selenium Rectifier, which converts AC to DC current, was introduced in America by I T & T and is manufactured by Federal in a wide range of sizes. In addition to television, home and mobile radio applications—Federal Selenium Rectifiers are used in all fields of industry for new and less costly product designs.



Federal's New Miniature Selenium Rectifier is revolutionizing design of television sets.

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WORLD UNDERSTANDING THROUGH WORLD COMMUNICATIONS

NEWS

Akin Points Up Joint Efforts in Electronics

Major General Spencer B. Akin, U. S. Army Chief Signal Officer, emphasized at a luncheon meeting of the Philadelphia chapter of the Armed Forces Communications Association Nov. 15 that many of today's advances in the field of communications are directly attributable to the joint efforts of industry and government and that this cooperation must continue. "Liaison between the government and the communications industry is achieving great advances in electronics and today's unsettled world conditions make imperative even greater cooperation," General Akin said. The lunceon of the AFCA chapter was held at the Hotel Barclay in Philadelphia in conjunction with the Signal Corps' exhibit at the World Hobby Exposition in the Commercial Museum in that city.

New Fairbanks CO

Major Robert D. Terry, Signal Corps, veteran of both the European and Pacific Theaters, has recently been assigned as head of the Alaska Communications System installations in the Fairbanks, Alaska, area, replacing Major James F. Campbell, veteran ACS officer, who is scheduled for retirement. Major Campbell states that he will return to Alaska to settle on a homestead near Seward upon retirement.

ACS Gets Inspection

Col. Fred P. Andrews, Signal Corps, Commanding Officer of the Alaska Communications System, with Headquatrers in Seattle, Washington, made a recent tour of inspection of ACS facilities in the Alaskan Territory. He was accompanied by Col. Marcelles R. Kunitz, Deputy Commander, ACS.

Signal Corps Visitors

Brigadier General Donald N. Yates, chief of the Air Force Weather Service, and a group of top executives of the General Electric Company were among recent visitors to the Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey. The General Electric delegation was headed by Dr. W. R. G. Baker, vice president in charge of the company's electronics division. Others in the group were Dr. A. W. Hull, associate director of the research laboratory; V. M. Lucas, manager of the government division; M. R. Johnson, designing engineer of the government division; W. Hausz, assistant manager of the electronics laboratory; O. W. Pike, manager of engineering of the tube division; F. G. Miller, Washington office representative, and S. W. Upham, government division representative.

Cloud Height Measurement

Accurate determination of cloud heights from aircraft in flight has been a problem which has confronted pilots and observers for some time, but the Signal Corps thinks it can lick it.

The Signal Corps Engineering Laboratories have developed a simple device which will enable an observer to eliminate the guesswork from his reports. The instrument consists of a modified illuminated gunsight which is mounted on a frame and coupled to two indexing arms which slide along a graduated scale. In use, the gunsight is trained on some prominent feature which is tracked for a short period of time, usually about one minute. During this tracking, one of the indexing arms remains fixed on the scale and the other moves.

At the end of the tracking period the vertical distance between the plane and the cloud may be computed easily from the air speed, time of tracking and the difference in scale readings at the two indexing arms. The actual cloud height may then be determined by adding or subtracting from the plane's altitude depending on whether the cloud is above or below the plane.

Camera Records Aerial Data

A new recording camera, to be used in making pictures in an airplane in flight, has been designed by the Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey. It is planned for use in meteorological research being conducted by the Army Signal Corps.

In study of meteorological conditions a permanent record is needed of readings of navigational instruments in aircraft in flight at the moment exposure is made by any of a network of cameras installed in the aircraft as research instruments.

The camera, now undergoing tests, includes a modified motion picture camera operating automatically. It is mounted in the bomb bay and is connected with a network of cameras distributed throughout the plane, taking photographs of a panel on which are mounted instruments similar to those used by a pilot operating a plane.

Each exposure taken by one of the network cameras relays an impulse to the recording camera which photographs the instrument panel, making a photographic record of altitude, air speed, temperature, direction and humidity, in addition to the azimuth and elevation of the particular camera taking the picture.

Later, after the film has been developed, the data is recorded and calculations made. Marked improvements in final analysis figures are expected to result.

CIVILIAN COMPONENTS

MARS Activation

Activation of a Military Amateur Radio System (MARS) to provide a backlog of trained radio communication personnel in case of local or national emergency has been announced jointly by the Army and Air Force.

The Army Signal Corps and the Air Force Director of Communications are authorized under joint regulations to use military equipment wherever practical in the training of MARS members. Experimental work will be encouraged. Training also will be furthered by an official bulletin.

Membership will be open to any individual in the Organized Reserve Corps, National Guard, or the Reserve Officers Training Corps who possesses a valid amateur radio operator's licens issued by the Federal Communications Commission or issued under regulations of an oversea commander. Applicants must agree to operate under regulations prescribed by the Secretary of the Army and the Secretary of the Air Force. Membership of civilians not in a ci-

NEWS

vilian component of the Army or Air Force is not presently authorized, but plans are being made for such membership.

Application for membership may be submitted to Signal and Communication officers of the Army Area or Air Force Area in which the applicant resides.

Personnel for supervision and control of MARS activities will be furnished by the Chief Signal Officer for the Army and the Director of Communications for the Air Force. There is no authority for additional personnel at other levels to conduct MARS activities. These activities will be assumed by officers in addition to present duties.

MARS policies will be guided by an advisory committee with both military and civilian members.

The full purpose of MARS, according to the official announcement made in Army and Air Force Regulations, is "to create interest and further training in military radio communication; to promote study and experimentation in military radio communication; to coordinate practices and procedures of amateur radio operations with those of military radio communication; and to provide an additional source of trained radio communication personnel in the event of a local or national emergency."

Reserve Units

The Department of the Army has announced that units in the Organized Reserve Corps numbered 10,022 as of October.

All units of the Organized Reserve are activated initially in Class "C." This indicates that a qualified commander has been selected and 60 per cent of the authorized officer strength is available to participate actively in the organization of the unit.

Upon activation in Class "C," many Army Reserve units are designated for ultimate expansion to Class "B" or Class "A," to be achieved as additional office and enlisted personnel become available for assignment. In some cases, however, a unit receives an ultimate designation of Class "C" and further expansion is not authorized.

A Class "C" Reserve unit authorized for expansion may be officially recognized as Class "B" after the minimum of 80 per cent of commissioned officers and 80 per cent of the enlisted cadre have been assigned by competent orders. An ultimate Class "A" Reserve unit may be expanded from Class "B" to Class "A" when the minimum of 80 per cent of commissioned officers and 40 per cent of the total authorized enlisted strength have been officially assigned.

An ultimate Class "C" Reserve unit may have a maximum of 100 per cent of the authorized officer strength. No enlisted men are assigned to ultimate Class "C" units.

Ultimate Class "B" units are authorized to obtain a total assigned strength of 100 per cent officers and a complete cadre of enlisted men.

Class "A" units of the Organized Reserve Corps which are authorized 48 weekly drill periods each year by the Department of the Army may be recruited to full complement of officers and enlisted men. All other Class "A" units are authorized an assigned strength of 100 per cent commissioned officers and 90 per cent enlisted men.

INDEX TO ADVERTISERS

Recently activated Organized Reserve Corps units listed below are currently authorized the officer and enlisted strengths indicated after each unit designation. Brigadier General Wendell Westover, Army Executive for Reserve Affairs, urged enlisted reservists, veterans, and Reserve officers, particularly those in grades of lieutenant and captain, to apply to local unit instructors for information concerning the many and varied assignment vacancies made possible by the activation of Reserve units. Position vacancies for the assignment of 954 Reserve officers and 5,178 enlisted men became available with the activation of these 105 units of the ORC.

ACS Reserve Unit

Plans are being completed for the activation of an Alaska Communications System Signal Corps Reserve Unit in the Seattle, Washington area, Headquarters of the ACS. The purpose of the unit is to augment the ACS in case of an emergency.

Composite Reserve Groups

Composite signal reserve groups were activated during 1947 for the purpose of maintaining interest in the active reserve until such time as a definite unit training plan could be introduced.

All commanding officers of composite groups were confronted with the problem of developing programs which would be of sufficient general interest to maintain satisfactory attendance levels and the problem was further complicated by the fact that reservists assigned to the groups worked and lived in various localities of the New York Metropolitan area.

In order to facilitate attendance at meetings and to encourage local interest, Colonel Joseph C. Berhalter, commanding the 158th Composite Group, introduced a plan for separate area training units.

Some reservists indicated a preference for meetings near their places of business and others preferred meetings near home. Therefore, five area training units were dsignated. A Manhattan unit met each month at Reserve Headquarters, in New York, and other units met in Long Island City, Flushing, L. I., Jamaica, L. I., and Hempstead, L. I.

Senior officers in each area were designated as officers in charge and it was their responsibility to select subjects and speakers for the area meetings. Lt. Col. James Mylod, Signal Unit Instructor, for New York District, assisted the commanding officers in arranging for guest speakers although at many meetings, the speaker was an officer of the particular unit.

The plan was highly successful and the fact that, during 1948, the attendance record of the 158th Group was substantially higher than that of other New York signal groups is attributed to the plan.

Affiliation Program Progresses

Approximately a third of the reserve units contemplated by the Signal Corps under the Army-industry affiliation program that began last year have been activated, according to the Office of the Chief Signal Officer. Announcement also was made of eight recently activated units.

Affiliated units are sponsored by civilian organizations, chiefly industrial, but come under the Organized Reserve Corps and have the same defense functions as other ORC units. Cadre and other key personnel come chiefly from the sponsoring organizations.

Latest units to be activated under the Signal Corps affiliations program are:

490th Signal Radio Relay Company, sponsored by RCA Communications, Inc., San Francisco, California.

822nd Signal Installation Company, sponsored by Automatic Electric Company, Chicago, Illinois.

491st Signal Heavy Construction Battalion, and Hq and Hq Detachment, 301st Signal Service Group, both sponsored by the Lincoln Telephone and Telegraph Company of Lincoln, Nebraska.

314th Signal Heavy Construction Battalion, and 217th Signal Depot Company, both sponsored by the Associated Telephone Company, Ltd., Santa Monica, California.

Hq and Hq Company, 321st Signal Base Depot, sponsored by the Graybar Electric Company, San Francisco, California.

800th Mobile Radio Broadcast Company sponsored by Del Mar Junior College, Corpus Christi, Texas.

The Automatic Electric Company, Lincoln Telephone and Telegraph Company, and the Associated Telephone Company, Ltd., all are members of the United States Independent Telephone Association.

Why This Issue

(*Continued from page 4*)

its technique. In fact, the term "televised photography" has been applied to it as being most apt.

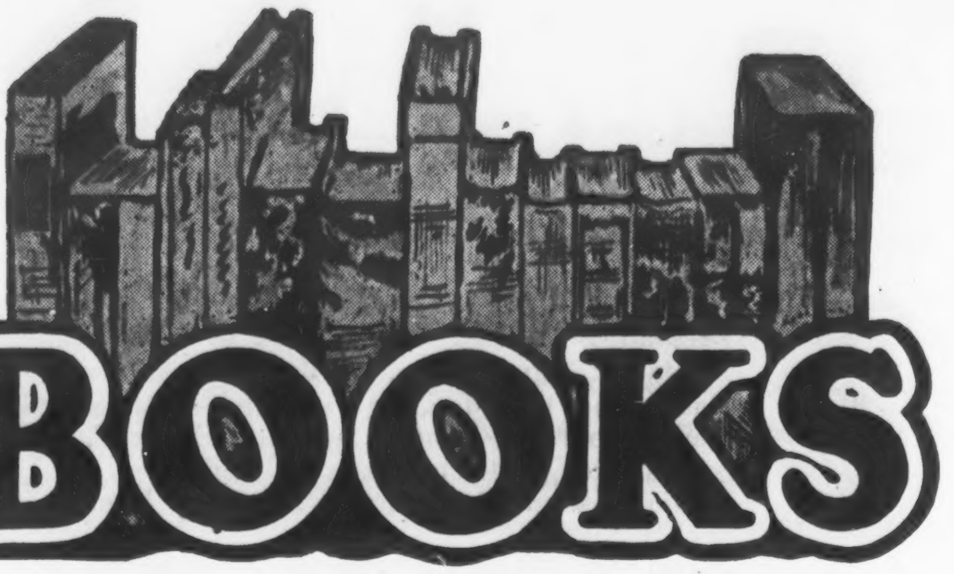
So there it is. Photography already belongs as an integral part of electronic communications and will belong even more in the future. And therefore it belongs in SIGNALS.

In getting back to the photographic half of our interest, which we've neglected for some time, we've jumped in with both feet and made this issue all photographic. This has caused some comment to the effect that we are going to make that a practice — catch up every once in a while all with one issue. But that is not, and will not be true.

Photography is back in SIGNALS to stay. Every issue from now on will give that science representation.

SIGNALS

Index of Feature Articles, September 1946 to February 1949



BOOKS AND SERVICES

M. K. ORMSBEE, Secretary

THE ARMY AIR FORCES IN WORLD WAR II (Vol. I — Plans and Early Operations). Edited by W. F. Craven and J. L. Cate, Chicago. University of Chicago Press. 788 pages. $5.00.

IN this volume, the first of seven, the formative period (January 1939 to August 1942) is covered. Subsequent volumes, which are to be released at 6-month intervals, will treat of European operations, Pacific operations, and personnel, material, and services.

Official histories are primarily the repository of the great mass of facts from which future historical writers may build. This is much more, for it is immensely more readable than most of its type. Documentation is thorough and concise, thirty-one fine maps and charts and sixty-two photographs are provided, a glossary of abbreviations and code names is included, and the index seems well above the average. The volume should go far in informing our people on an important phase of air-age history.

Ordnance

ATOMIC ENERGY, by Karl K. Darrow. John Wiley & Sons. $2.00.

IN four chapters Dr. Darrow's latest volume carries the reader over the basic physics of nuclear fission. Since the material was originally presented at the Norman Wait Harris lectures at Northwestern University, Dr. Darrow has wisely preserved the colloquial style. As a result, the text is as easy to read as the lectures must have been easy to follow. It is not always appreciated by writers and speakers that a new idea requires a definite length of time to sink into the reader's mind. During that time, the eyes (or ears) should be occupied with relatively "easy" material which does not claim too much from the reader's attention. This is the rhythm of effort, "work, relax, work, relax" which is natural to man in all his activities.

Beginning with a description of the atom, Dr. Darrow describes the properties of its electrons, protons and neutrons, and outlines the forces that hold them together and force them apart. He shows how the nucleus can be rearranged by bombarding it, and what happens when heavy nuclei, such as uranium, are broken up. Finally, he describes the chain reaction, in which the neutrons set free by fission produce still more neutrons.

Passing briefly over the "nuclear bomb," Dr. Darrow reviews some of the peaceable applications and products of fission, such as power production.

Atomic Energy is recommended to readers who are interested in nuclear fission, but yet lack the time or the background to profit from the more elaborate texts that are available on the subject.

Bell Laboratories Record

ELECTRONIC CIRCUITS AND TUBES, by the War Training Staff of the Cruft Laboratory, Harvard University. Published (1947) by the McGraw-Hill Book Co. 933 pages. $7.50.

THE scope of this text ranges from complex algebra to the Fournier transform, from sinusoidal voltage to waveshaping circuits, from resonance to phase modulation, from regenerative one-tubers to FM receivers. A surprisingly broad coverage of each subject is given, and although necessarily limited, enough mathematics is given to reinforce and support the discussion.

Written as a result of the Cruft Laboratories work in preradar courses, the book does not offer too many evidences of its having had eleven authors. It is readable and should serve as an excellent reference for information on the many branches of the radio field outside of any reader's particular specialty. With the introductory material on ac circuits and the appended material on mathematics and electricity, it might well serve as an extracurricular text for a student not too conversant with electrical engineering.

Proceedings, I.R.E.

NO BUGLES TONIGHT, by Bruce Lancaster. Atlantic - Little Brown, $3.00.

A CIVIL WAR novel based on exhaustive research of the Andrews raid and of Union soldiers behind the Confederate lines. The first six Medals of honor ever awarded went to these men. A fascinating story.

UTAH BEACH TO CHERBOURG.

THE last volume of the Army Historical Division's American Forces in Action series, *Utah Beach to Cherbourg*, has been placed on sale.

This volume tells how the right wing of the Allied forces that landed in Normandy isolated, and finally captured, the great deep-water port of Cherbourg. The attack began with a parachute drop of more than 13,000 men on the night of June 6-7, 1944, followed by a three-division amphibious assault. These forces swept westward to cut off the Cotentin peninsula, and then attacked Cherbourg from the South. In the final assault on the city, they received the greatest amount of direct air support ever provided for American Infantry up to that time. The main units participating in this action were the 82nd and 101st Airborne Divisions and the 4th, 9th, 79th and 90th Infantry Divisions.

Author of this volume is Major Roland G. Ruppenthal, who was historian of the VII Corps, and came ashore at Utah Beach on D-Day. Major Ruppenthal received a Bronze Star for his service as a combat historian and is now a civilian employee of the Historical Division.

GRIDIRON GRENADIERS, by Tim Cohane. 300 pages. G. P. Putnam's Sons. $3.50.

THE epic tale of football at West Point from 1890 to 1947. The pages sparkle with accounts of brilliant games and brilliant players. You realize what a real part football as a game has played in developing military leaders—and what an astonishing number of these football heroes paid the supreme penalty in the more serious game of World War II. It shows that football is necessary at the service academies as an essential to the preparation of the leaders of the Armed Forces.

THE AIR OFFICER'S GUIDE. 547 pages. The Military Service Publishing Company. $3.50.

THIS volume serves as a clear, concise, personal handbook for officers in air units whether in Air Force, Army, Navy, or Marines. It covers financial matters, their rights as citizens in the Service, opportunities available to them as career men, and it gives short but adequate descriptions of military procedure in all its various aspects.

RADIO AT ULTRA-HIGH FREQUENCIES, Vol II. 438 pages. Published by RCA Review, Radio Corporation of America, RCA Laboratories Division. $2.50.

RADIO at Ultra-High Frequencies, Volume II, is the eighth volume in the RCA Technical Book Series and the second on the general subject of radio at the higher frequencies. Radio at Ultra-High Frequencies, Volume I, covered the period 1930-39. The present volume includes the years 1940-47.

Papers are presented in seven sections: antennas and transmission lines; propagation; reception; radio relays; microwaves; measurements and components; and navigational aids. As additional sources of reference, the appendices include a bibliography in the field of ultra-high-frequency radio, and summaries of all papers appearing in Radio at Ultra High Frequencies, Volume I, which is now out of print.

Radio at Ultra-High Frequencies, Volume II, is, therefore, being published for scientists, engineers, and others interested in the field of ultra-high-frequency radio, with the sincere hope that the material assembled may help to speed developments in the radio-frequency bands.

THE NEW ARTICLES OF WAR, by Colonel Frederick Bernays Wiener, 96 pages. $1.00.

BOTH enlisted men and officers on courts will need this book.

Colonel Frederick Bernays Wiener, recognized as one of the country's top experts on military law and its administration, has written a study of the New Articles of War which will prove indispensable to well-informed officers. The new articles go into effect January 1, 1949, and it will be absolutely necessary that every man in the Army concerned in any way with disciplinary problems or the administration of the Articles of War, be acquainted with the new penalties, regulations and procedures.

Colonel Wiener has written a long explanation of the impact the new Articles of War will have on the administration of military justice, comparing the new and old texts of the Articles to make the differences and consequences of the changes clear.

NONCOM'S GUIDE. 336 pages. By The Military Service Publishing Company. $2.00.

THE *Noncom's Guide* is an encyclopedia of information vital to all noncommissioned officers of the Army of the United States. In this book is gathered in one place practically all the information considered necessary for the use of a noncommissioned officer of the Army, conveniently arranged and indexed.

STAR-SPANGLED RADIO, by Edward M. Kirby and Jack W. Harris. Ziff Publishing Co. $3.50.

To the public, "radio" means the receiving set in the home and what comes out of it in the form of news and entertainment. It is for this public that the book, with its catchy title, was written.

The general theme is an unfolding story of how radio broadcasting was used in World War II. That it was successfully used, in spite of the lack

of pre-war plan, is attributed to the fact that experienced people from the industry were used in planning, direction and operation. The importance of news and entertainment to the troops, of news of the military forces and action to the American public, and of the effect of radio broadcasting on the accomplishment of the war mission, are well portrayed.

Criticism of the British Broadcasting Corporation is treated with a candor that leads one to suspect that it is "pointed up" as an object lesson of what will happen if the radio broadcasting people don't insure their freedom from like bureaucratic control. As such, it should serve a useful purpose.

The admonition to the industry that it take steps to prepare a mobilization plan gives the book a serious vein, and is in keeping with the general spirit of the times. The warning — that if the industry doesn't prepare such a plan the military will — might be taken in several ways. If it has the effect of getting the plan prepared, the military are not thin-skinned enough to resent being used as the abhorred alternative.

The book is interestingly written, maintaining a lightness, brevity, and change of pace that will attract the ordinary reader interested in stories of personal war experiences. It is well worth the few hours required to read it.

Q. M. Review

PRINCIPLES OF PHOTOGRAPHIC REPRODUCTION, by Carl W. Miller. 353 pages. The Macmillan Co. $4.50.

A RIGOROUS, systematic treatment of modern photographic principles and procedures, covering lens optics, monochrome reproduction and color. Important printing processes are also covered. Color photography receives unusually full treatment, with criteria for appraising the quality of color reproduction and discussion of the effectiveness of modern masking methods, the Kodacolor process, etc. Precise quantitative methods are emphasized throughout.

THE THEORY OF THE PHOTOGRAPHIC PROCESS, by C. E. Kenneth Mees. 1124 pages. The Macmillan Co. $13.20.

THE leading authority on the subject presents here, in one comprehensive volume, a review and summary of the scientific work of the past fifty years which has contributed to the knowledge of the photographic process. Dr. Mees has synthesized into a complete, clearly organized exposition of the whole subject information heretofore largely scattered through literature in several languages and in the great diversity of scientific journals. The book deals with the composition and properties of photographic light-sensitive materials; the factors which control their sensitivity to light; the changes induced in them by the action of light; the nature of the process of development; the properties of the final image; and the measurement of its tone values. The book is fully illustrated with diagrams and halftones. Complete bibliographies accompany each chapter.

FUNDAMENTALS OF ENGINEERING ELECTRONICS, by William G. Dow. 604 pages. John Wiley & Sons, Inc. $5.50.

PRINCIPLES of importance in engineering work are selected for study; illustrations of these principles are drawn from engineering practice; and physical concepts are so treated as to permit ready determinations of magnitudes. Reasoning from purely physical concepts has been used rather than mathematical formulation, wherever the latter could be avoided without loss of definiteness. However, since a large part of the subject matter requires mathematical analysis for the establishment of proper quantitative concepts, in those cases mathematical methods have been used freely.

APPLIED ELECTRONICS, by the Electrical Engineering Staff at the Massachusetts Institute of Technology. 772 pages. John Wiley & Sons, Inc. $6.50.

FOR those engineers with little knowledge of electronics, the book presents an understandable discussion starting from elementary facts and principles. For those with a fair but inadequate knowledge, its foundational treatment and practical illustrations and problems will provide a useful means for further study and reference.

ULTRAHIGH FREQUENCY TRANSMISSION AND RADIATION, by Nathan Marchand. 322 pages. John Wiley & Sons, Inc. $4.50.

THIS new book presents the basic principles of UHF so they can be practically applied in systems of mobile and relay communications; frequency modulation; relay and color television; pulse time modulation; and in many other specialized applications. It was written for use both as a text book in a prepared course in electrical engineering and as a text for self study by the practicing engineer.

A mathematical approach is used in the derivations with a detailed discussion of the results—to give a perception of the phenomena taking place. No attempt is made to cover the entire specialized field of transmission, but the fundamental principles are covered in full.

All derivations and developments in the text lead to results that can be used on the job. MKS units are used throughout. The author deals with transmission lines, antennas, and wave guides as equipmenut that has to be designed, constructed, and used.

FUNDAMENTALS OF ELECTRIC WAVES, by Hugh H. Skilling. 244 pages. John Wiley & Sons, Inc. $4.00.

THIS new edition begins with a discussion of electric and magnetic theory leading to Maxwell's equations. Then radiation, wave propagation, antennas, transmission lines and wave guides are dealt with. Vector analysis is used. For an understanding of the book, only a knowledge of general physics and integral calculus is necessary. The second edition contains much more complete discussions on the following subjects than were included in the first edition: wave guide, wave propagation, antennas, reflection, and propagation in ionized regions. Rationalized meter-kilogram-second units are used in place of the Gaussian or centimeter-gram-second system. Additional illustrative problems are given with each chapter. They serve to give the student practice in the application of the principles under discussion and to supplement the information contained in the text.

HIGH FREQUENCY THERMIONIC TUBES, by A. F. Harvey. 244 pages. John Wiley & Sons, Inc., $3.50.

GIVES the details of these various important new tubes and describes the experimental work that has been done with them. The influence of frequency of operation is discussed and the limitations of normal type tubes at very high frequencies are pointed out. Much space is devoted to consideration of special thermionic tubes which are of particular value at these frequencies. Emphasis is mostly laid on the electrical properties of the thermionic tubes themselves but the methods of measurement are described in detail with the intention of indicating the practical application of these tubes to high frequency problems.

HYPER AND ULTRA-HIGH FREQUENCY ENGINEERING, by Robert L. Sarbacher and William A. Edson. 644 pages. John Wiley & Sons, Inc. $6.00.

PRESENTS the unchanging fundamentals essential for an understanding of new communications developments. Performance of transmission lines both of conventional and hollow form is discussed in terms of circuit and field theory, and operation of the more important forms of hyper-frequency generators is covered. All phases of hyper-frequency—including generation, transmission and radiation of these quasi-optical waves—are discussed in detail.

At no point is special advanced information on the part of the reader assumed. The treatment is comprehensive, concise, and practical rather than purely academic. Charts, diagrams and illustrations aid in clarifying obscure points. Practical problems, not requiring advanced mathematical methods for solution, apply and review the technical data covered in each chapter.